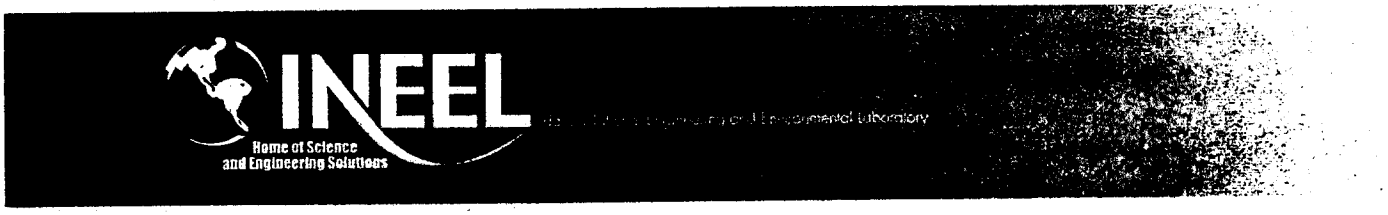
DOE/ID-10851
Revision 3
October 2004

U.S. Department of Energy
Idaho Operations Office

INEEL CERCLA Disposal Facility Construction Quality Assurance Plan



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Project No. 23350
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Prepared for the
U.S. Department of Energy
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ABSTRACT

This Construction Quality Assurance Plan describes the construction quality assurance responsibilities and procedures for work anticipated during Cell 2 construction for the INEEL CERCLA Disposal Facility. This shall include construction of the liner, leachate collection piping, and operation layer for Cell 2. This Construction Quality Assurance Plan is prepared as a stand-alone document to be implemented by an independent, third-party construction quality assurance certifying officer.

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TABLES

ACRONYMS

ASTM	American Society for Testing and Materials
BIC	Balance of INEEL Cleanup
BBWI	Bechtel BWXT Idaho, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CQA	construction quality assurance
CQC	construction quality control
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
GCL	geosynthetic clay liner
HWMA	Hazardous Waste Management Act
ICDF	INEEL CERCLA Disposal Facility
INEEL	Idaho National Engineering and Environmental Laboratory
LCRS	leachate collection recovery system
LDRS	leak detection recovery system
MCP	management control procedure
NCR	nonconformance report
PLN	plan
PRD	program requirements document
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RD/CWP	remedial design/construction work plan

SBL	soil bentonite liner
SLDRS	secondary leachate detection recovery system
SPC	specification
STR	subcontract technical representative
UCL	upper control limit
USC	*United States Code*

INEEL CERCLA Disposal Facility Construction Quality Assurance Plan

SECTION I—GENERAL

1. INTRODUCTION

The U.S. Department of Energy (DOE) has tasked Bechtel BWXT Idaho, LLC (BBWI) to construct a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) disposal facility and evaporation ponds at the Idaho National Engineering and Environmental Laboratory (INEEL) near Idaho Falls, Idaho. Disposal of remediation waste, primarily contaminated soil, into the INEEL CERCLA Disposal Facility (ICDF) is scheduled to begin in 2004. This Construction Quality Assurance (CQA) Plan describes the quality assurance (QA) activities required for constructing the lining system, operation layer, and leachate collection piping of the ICDF landfill.

1.1 Purpose

During construction, QA activities shall be required to ensure the following:

- Construction of the liner system, leachate collection piping, and operation layer are performed in accordance with the approved construction drawings, technical specifications (SPC-591), and the *INEEL CERCLA Disposal Facility Remedial Design/Construction Work Plan* (DOE-ID 2002)
- Borrow and disturbed areas are restored in accordance with the technical specifications
- Requirements of regulatory agencies related to documentation are satisfied
- Construction of the ICDF landfill and evaporation ponds can be certified.

This CQA Plan has been prepared to describe the activities that shall be performed during construction of the lining system, leachate collection system, and operation layer of Cell 2. Procedures invoked by this CQA Plan are intended to identify problems that may occur during construction and to document that these problems are corrected before accepting the construction.

This CQA Plan is intended to satisfy the regulatory requirements and guidance established in 40 *Code of Federal Regulations* (CFR) 264.19, "Construction Quality Assurance Program," and the U.S. Environmental Protection Agency's (EPA's) technical guidance document *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993).

This CQA Plan is intended to be implemented by an independent, third-party CQA certifying officer familiar with EPA's technical guidance document *Quality Assurance and Quality Control for Waste Containment Facilities* and this CQA Plan. The CQA certifying officer will be supported by the number of CQA representatives necessary to implement the requirements in this CQA Plan and document the work.

1.2 Scope

This CQA Plan establishes general administrative and documentation procedures that shall be applicable for selected activities of construction. With respect to responsibilities, personnel qualifications, and specific inspection and testing activities, this CQA Plan addresses only those activities associated with the soils, geosynthetics, and related liner and leachate collection system piping components for the ICDF Cell 2. Specific procedures relating to these CQA activities that are not addressed in this plan shall be performed in accordance with manufacturers' recommendations or as directed by BBWI. This CQA Plan is divided into sections to provide quick access to CQA requirements for individual liner components. The sections are listed below:

- Section I, "General"
- Section II, "Soils Construction Quality Assurance"
- Section III, "Geosynthetic Clay Liner Construction Quality Assurance"
- Section IV, "Geomembrane Construction Quality Assurance"
- Section V, "Geotextile Construction Quality Assurance"
- Section VI, "Geocomposite Construction Quality Assurance"
- Section VII, "Polyethylene Pipe and Fittings"
- Section VIII, "Construction Quality Assurance Documentation."

1.3 Change Control Procedures

The CQA Plan and all implementing procedures are subject to the change control procedures described in Section VIII of this CQA Plan.

1.4 Regulatory Agencies

The ICDF Complex does not require a permit. It will be an engineered facility meeting the applicable or relevant and appropriate requirements, the remedial action objectives, and the remedial guidelines documented in the *Final Record of Decision Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999); DOE Order 435.1, "Radioactive Waste Management"; Resource Conservation and Recovery Act (RCRA) Subtitle C: Idaho Hazardous Waste Management Act (HWMA); and Toxic Substances Control Act polychlorinated biphenyl landfill design and construction requirements. The complex's primary purpose is to provide a disposal facility for CERCLA-generated waste at the INEEL to satisfy the requirements of the *Final Record of Decision Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999). This CQA Plan is specifically designed to support this and regulatory requirements.

The regulatory agencies are responsible for oversight and implementation of the responsibilities identified in the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991). As provided in the Agreement, each Party to the Agreement is represented by a project manager. The project manager shall:

- Manage INEEL remedial activities, including the ICDF construction, for their respective agencies pursuant to the Agreement and Action Plan
- Serve as primary contacts and coordinators for their respective agencies for purposes of implementing the Agreement and Action Plan
- Prioritize work for their respective agencies
- Coordinate activities of project managers, who are identified by the project managers, as necessary.

2. PROJECT ORGANIZATION

This section describes the project organization for the Phase 2 ICDF construction. The following subsections address the organizations involved in the construction, their respective roles in construction activities, and the methods of interactions between organizations.

2.1 Responsibility and Authority

The QA organization chart for the ICDF Cell 2 construction is shown in Figure 2-1. The project organization is divided into two main groups consisting of the project team and field team. The project team consists mainly of management and will be onsite periodically during the ICDF construction to monitor progress, meetings, dispute resolutions, and as needed to ensure that the work is implemented in accordance with the construction drawings, technical specifications, the Remedial Design/Construction Work Plan (RD/CWP) (DOE-ID 2002), and agreements made with the regulatory agencies. The field team will consist of the key personnel onsite during construction. The organization is based on a line and staff concept. Solid lines on the organization chart represent project responsibilities such as scope, cost, and schedule. The dashed lines represent the functional responsibilities of staff for QA, design, and health and safety. The responsibilities and reporting requirements for each project team member are described in the following sections.

2.1.1 Project Team

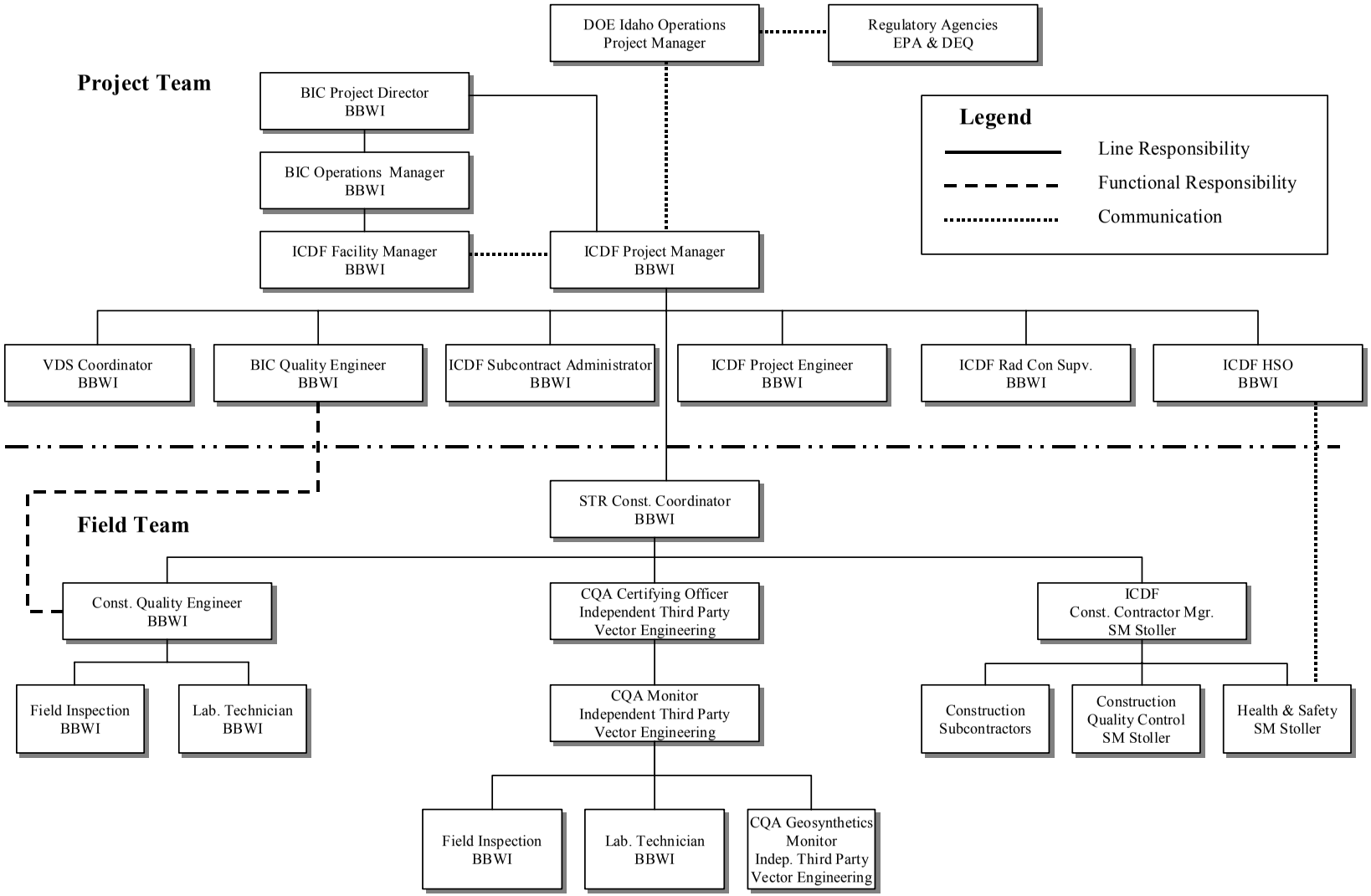
2.1.1.1 U.S. Department of Energy Idaho Operations Office Project Manager. The U.S. Department of Energy Idaho Operations Office (DOE-ID) project manager is the owner's representative and is responsible for project funding and implementing the responsibilities identified in the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991). The DOE-ID project manager will keep the regulatory agencies informed of ICDF construction activities and progress.

2.1.1.2 Idaho Completion Project—Balance of INEEL Cleanup Project Director. The Balance of INEEL Cleanup (BIC) project director is responsible for all BIC activities, including the ICDF Cell 2 construction. The BIC project director serves as the primary contact and coordinator for activities performed at the ICDF for purposes of implementing the Federal Facility Agreement and Consent Order and Action Plan (DOE-ID 1991) and interfaces with the facility managers, as required.

2.1.1.3 Balance of INEEL Cleanup Operations Manager. The BIC operations manager is responsible for ensuring the safe operation of all BIC facilities in accordance with established company procedures. The BIC operations manager interfaces with the ICDF facility manager and project manager to ensure that ICDF activities are smoothly and safely integrated with ongoing site activities and vice versa.

2.1.1.4 ICDF Facility Manager. The ICDF facility manager is responsible for the overall operation of the ICDF. The ICDF facility manager will coordinate directly with the ICDF project manager, the implementation subcontractor, and other facility managers to ensure safe and efficient operation of the ICDF.

2.1.1.5 ICDF Project Manager. The ICDF project manager will have overall responsibility for the ICDF construction and will interface with the ICDF facility manager, other remediation site managers, and the ICDF project engineer. The ICDF project manager will direct the activities of the ICDF project and field team staff, including the quality engineer (for ICDF activities), procurement agent, ICDF project engineer, ICDF health and safety officer, and subcontract technical representative. Additionally, the ICDF



Note: CQA Certifying Engineer has the authority and responsibility to stop work and recommend remedial actions to the regulatory agencies.

Figure 2-1. Quality assurance organization chart for Cell 2 construction.

project manager functions as the point of contact for the ICDF construction subcontractor. Functionally, the ICDF project manager reviews and approves quality assurance reports submitted by the ICDF CQA certifying officer.

2.1.1.6 ICDF Project Engineer. The ICDF project engineer is responsible for providing technical support to the ICDF project team. The ICDF project engineer is supported by other personnel for reviewing and/or preparing technical documents related to engineering design and analyses. The ICDF project engineer reports to the ICDF project manager.

2.1.1.7 ICDF Quality Engineer. The ICDF quality engineer has overall responsibility for the quality control (QC) and QA of remedial activities performed at the ICDF. The ICDF quality engineer is responsible for the construction quality engineer and field inspection team in the field. The ICDF quality engineer reports quality issues related to the ICDF construction directly to the ICDF project manager.

2.1.1.8 Procurement Agent. The procurement agent is responsible for all purchasing, payables, accounting, and contract administration activities, including approval of contract modifications for the construction subcontractor. The CQA certifying officer contractually reports to the procurement agent. The procurement agent reports to the ICDF project manager on ICDF-related procurement activities.

2.1.1.9 ICDF Construction Subcontractor. The ICDF construction subcontractor is responsible for implementing the approved design by providing the necessary labor, equipment, materials, and all other resources necessary to construct the ICDF.

2.1.1.10 ICDF Health and Safety Officer. The ICDF health and safety officer has overall responsibility for health and safety for the ICDF project. The ICDF health and safety officer reports to the ICDF project manager and is supported by the design and construction subcontractor's safety and health officer in the field.

Note that when the above individuals are designated to perform specific functions described in this CQA Plan, the reference to these individuals includes their designee or an alternate who can function on their behalf.

2.1.2 Field Team

2.1.2.1 Subcontract Technical Representative/Construction Coordinator. The subcontract technical representative (STR)/construction coordinator oversees the ICDF construction activities in the field and is the onsite representative for the ICDF project manager.

2.1.2.2 Construction Manager and Site Superintendent. The construction manager and superintendent represent the ICDF construction subcontractor and will be responsible for implementing the ICDF construction activities. The construction manager will have overall responsibility for all construction activities related to the ICDF. The superintendent will control the day-to-day construction tasks and will be the point of contact for the field personnel. The construction manager will visit the site periodically to ensure that work is progressing smoothly and will be a substitute for the superintendent, if necessary. The construction manager and superintendent will be supported by the internal QC engineer and safety and health officer and will report to the STR/construction coordinator and the ICDF design and construction subcontractor's project team.

2.1.2.3 Construction Subcontractors. Construction subcontractors will include specialty companies retained by the ICDF design and construction subcontractor to perform specific work activities

at the ICDF such as earth moving, geosynthetic lining installation, piping, and fence installation. The construction subcontractors will report directly to the superintendent.

2.1.2.4 Internal Construction Quality Control. The design and construction subcontractor will provide a construction QC engineer who will support the superintendent. The primary responsibility of the construction QC engineer will be to ensure that the work is performed in accordance with the technical specifications and construction drawings. Specific duties of the construction QC engineer will include activities such as preparing subconstruction submittals, field documentation, and interfacing with the CQA certifying officer.

2.1.2.5 Safety and Health Officer. The safety and health officer will support the superintendent in ensuring that all work activities are performed in a safe manner and in accordance with the project-specific health and safety plan. Functionally, the safety and health officer will provide health and safety information related to the ICDF construction to the project team's ICDF health and safety officer.

2.1.2.6 Construction Quality Engineer. The construction quality engineer reports to the ICDF quality engineer and STR/construction coordinator and is responsible for the field inspection team and quality assurance testing laboratory. The construction quality engineer will be responsible for providing the necessary number of qualified field inspection personnel and laboratory services for the CQA monitor and CQA certifying officer.

2.1.2.7 Radiological Control Supervisor. The radiological control supervisor is responsible for ensuring that all radiological controls are in place and that work practices are in compliance with Program Requirements Document (PRD) –183, "Radiological Control Manual."

2.1.2.8 Field Inspector. The field inspector reports to the construction quality engineer and will be a CQA representative, functionally supporting the CQA monitor and CQA certifying officer. The field inspector's function will be to perform testing and observations in accordance with this CQA Plan under the direction of the CQA monitor and CQA certifying officer.

2.1.2.9 Soils Laboratory Technicians. The laboratory technicians will report to the construction quality engineer and functionally will provide the QA testing required by this CQA Plan and as requested by the CQA monitor and CQA certifying officer.

2.1.2.10 Construction Quality Assurance Monitor. The CQA monitor will report directly to the CQA certifying officer and will be a CQA representative supported by the field inspection team and laboratory technician. The CQA monitor will ensure that all CQA tests are performed in accordance with this CQA Plan and accepted procedures.

2.1.2.11 Construction Quality Assurance Certifying Officer. The CQA certifying officer will be an independent third party and will have the overall responsibility of implementing this CQA Plan and shall directly supervise the CQA monitor, field inspection team, and laboratory technicians. Functionally, the CQA certifying officer will submit CQA reports to the ICDF project manager. The CQA certifying officer will be a registered professional engineer in Idaho and will have the authority to certify that the ICDF is constructed in accordance with the approved plans and specifications and any approved changes. An independent third party is a company retained by the owner (or the owner's representative) that is a separate entity from the company performing the construction. The CQA certifying officer also has the authority and responsibility to stop work and recommend remedial actions to the regulatory agencies, if the construction subcontractor is not adhering to the CQA Plan. Even though the CQA certifying officer reports to the STR/construction manager and the ICDF project manager, he or she has the independence and authority to stop work.

2.2 Project Meetings

This section includes a discussion of the various progress and status meetings that will be held throughout the ICDF construction. The purpose of the meetings is to discuss work progress, planning, and other issues related to construction. A portion of these meetings can be dedicated to CQA issues, as necessary, to provide an opportunity for the CQA team to express concerns regarding quality, to relay test results, and to ensure good communication between all organizations involved in the construction of the ICDF. The CQA monitor is responsible for publishing and distributing the meeting minutes.

2.2.1 Preconstruction Meeting

A preconstruction meeting will be scheduled prior to beginning construction activities described in Section 6.1 that require independent CQA verification at the ICDF. At a minimum, the meeting will be attended by the ICDF project manager, construction manager, STR/construction coordinator, CQA monitor, and CQA certifying officer. A portion of the meeting will be dedicated to the discussion of QA issues. These CQA topics shall include, but not be limited to, the following:

- Reviewing the responsibilities of each organization
- Discussing the authority of agencies and project and field team members to order work stoppages
- Reviewing lines of authority and communication for each organization
- Providing each organization with all relevant CQA documents and supporting information
- Familiarizing each organization with the CQA Plan and its role relative to the design criteria, plans, and specifications
- Determining any changes to the CQA Plan that may be needed to document that the facility shall be constructed to meet or exceed the specified design requirements
- Discussing the established procedures or protocol for observations and tests, including sampling strategies
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting, including “stop work” conditions
- Reviewing methods for documenting and reporting inspection data
- Reviewing methods for distributing and storing documents and reports
- Reviewing work area security and safety protocol
- Reviewing the proposed project schedule
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events
- Conducting a site walk-around to review construction materials and inspect equipment storage locations

- Action items, assigned actionees, and minutes shall be recorded and transmitted to the required distribution list and to meeting attendees.

2.2.2 Daily Meetings

The superintendent will conduct prejob briefings at the work area. The participants shall include, at a minimum, the construction field personnel, including lower-tiered subcontractors and CQA representatives. The primary purpose of these meetings is to address the day's planned activities and health and safety issues. Following the prejob meeting, the CQA representatives will meet to discuss CQA activities planned for that day and interface needs with the construction personnel. The topics typically covered are listed below:

- Review the previous day's activities and accomplishments
- Review the work location and activities for the day (plan of the day)
- Discuss the construction subcontractor's personnel and equipment assignments for the day
- Address scheduling of resources for upcoming work
- Review any new test data
- Discuss any potential construction problems, including unexpected subsurface conditions that may jeopardize the ability to site the landfill cell or evaporation ponds according to Section 4.3.2.1
- Discuss CQA-planned activities and interface needs
- Discuss any health and safety issues
- Ensure proper distribution of formal meeting minutes (including soil and liner contractor input).

The documentation shall be distributed to a list of individuals, to be determined at the preconstruction meeting.

2.2.3 Construction Progress Meetings

Construction meetings will be held at the site to discuss construction progress. At a minimum, the biweekly progress meetings shall be attended by the superintendent and/or construction manager, the STR/construction coordinator, the ICDF project manager or designated alternate, and the CQA certifying officer or designated alternate. The purpose of the meeting is to accomplish the following:

- Review the previous week's activities and accomplishments
- Review claims, change orders, delays, and similar items
- Review planned activities for the upcoming week
- Finalize resolution of problems from the previous week
- Discuss the potential problems with the work planned for the upcoming week.

Minutes will be recorded by a party identified by the STR/construction coordinator and transmitted to the required distribution list and meeting attendees.

2.2.4 Problem or Work Deficiency Meetings

Meetings shall be convened as necessary to address construction changes, inspection deficiencies, and nonconformances. Deficiencies observed during construction by the CQA representatives shall be immediately brought to the attention of the superintendent and CQA certifying officer. These deficiencies will be tracked in the CQA representative's field logbook until resolution and included in the daily summary report. These documents shall include the description of the deficiency and actions taken or to be taken to resolve.

2.3 Hold Points

Mandatory hold points shall be established for certain key activities. At these points, the ICDF design and construction subcontractor shall cease work on the affected activity until it has been reviewed by the CQA monitor. Typical hold points would be between construction of liner system components and final operations layer placement. The schedule for hold points shall be determined when the construction subcontractor develops the construction schedule for the project.

3. PERSONNEL QUALIFICATIONS AND TRAINING

This section describes the qualifications and training required for CQA personnel. All documentation relating to qualifications shall be maintained with the project CQA records.

3.1 Construction Quality Assurance Certifying Officer

The CQA certifying officer shall be employed by an independent third party and have landfill construction certification experience. The CQA certifying officer shall, at a minimum, be a registered civil professional engineer in good standing in the State of Idaho; possess a bachelor's degree in civil or construction engineering, geotechnical engineering, engineering geology, or a closely related discipline; and shall have sufficient practical, technical, and managerial experience to successfully direct the CQA activities discussed in this CQA Plan. The CQA certifying officer's qualifications shall be documented by training records and a professional resume showing significant field experience in landfill construction and low-permeability clay liner construction, having directed CQA activities at a minimum of five landfill construction projects or a minimum of 300 acres of combined landfill area certifying experience. Qualification documentation shall be reviewed by the ICDF project engineer and quality engineer. If acceptable, a project certification form shall be completed and retained in the project QA records. Certifications shall be valid for a period of 1 year, after which they must be renewed.

The CQA certifying officer shall receive formal training in the requirements of the BBWI quality program, including but not limited to, the following: documentation, receiving inspection, equipment calibration, design control, and personnel training. The CQA certifying officer also shall have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan as well as activity-specific health and safety plans.

3.2 Construction Quality Assurance Monitor

At a minimum, a CQA monitor shall have a high school diploma and at least 5 years of construction-related experience, including at least 3 years of experience conducting CQA monitoring for earthwork construction, including a minimum of three landfill construction projects or a minimum of 50 acres of combined landfill area experience, or a bachelor of science degree from a 4-year college or university, and at least 2 years of experience conducting CQA monitoring for earthwork construction, including a minimum of three landfill construction projects. The CQA monitor must be capable of performing work with little or no daily supervision and shall be certified by a program approved by the CQA certifying officer. The CQA monitor shall be familiar with EPA's technical guidance document *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993).

Qualifications of the CQA monitor shall be documented by training records and professional resumes and shall be reviewed by the ICDF project engineer and CQA certifying officer and, if acceptable, shall be certified in the same manner noted in Section 3.1 above. Certifications shall be valid for a period of 1 year, after which they must be renewed.

The CQA monitor shall receive formal training in the BBWI quality program's requirements, including but not limited to, the following: documentation, receiving inspection, equipment calibration, design control, and personnel training. The CQA monitor also shall have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan as well as activity-specific health and safety plans.

3.3 Field Inspector

At a minimum, a field inspector shall have a high school diploma and at least 2 years of construction-related experience, including at least 1 year of experience conducting CQA monitoring for earthwork construction or a bachelor of science degree from a 4-year college or university and at least 6 months of experience conducting field inspection for earthwork construction. The field inspector must be capable of routine engineering technician work under general daily supervision and shall be certified by a program approved by the CQA certifying officer. The field inspector shall be familiar with EPA's technical guidance document *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993).

Qualifications of a field inspector shall be documented by training records and professional resumes and shall be reviewed by the ICDF project engineer and CQA certifying officer and, if acceptable, shall be certified in the same manner noted in Section 3.1 above. Certifications shall be valid for a period of 1 year, after which they must be renewed.

The field inspector shall receive formal training in the requirements of the BBWI quality program, including, but not limited to, the following: documentation, receiving inspection, equipment calibration, design control, and personnel training. The field inspector also shall have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan as well as activity-specific health and safety plans.

3.4 Soils Laboratory Technician

At a minimum, a laboratory technician shall have a high school diploma and at least 5 years of construction materials laboratory testing-related experience, including at least 3 years of experience performing geotechnical laboratory tests for earthwork construction, including compacted low-permeability clay, or a bachelor of science degree from a 4-year college or university and at least 2 years of experience performing geotechnical laboratory tests for earthwork construction, including low-permeability clay. The laboratory technician must be capable of routine laboratory technician work under general daily supervision and shall be certified by a program approved by the CQA certifying officer.

Qualifications of a laboratory technician, including training records and professional resumes, shall be reviewed by the ICDF project manager and CQA certifying officer and, if acceptable, shall be certified in the same manner noted in Section 3.1. Certifications shall be valid for a period of 1 year, after which they must be renewed.

A laboratory technician shall receive formal training in the requirements of the BBWI quality program, including, but not limited to, the following: documentation, receiving inspection, equipment calibration, design control, and personnel training. The laboratory technician also shall have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan, as well as activity-specific health and safety plans.

3.5 Geosynthetic Laboratory

The geosynthetic laboratory will be selected by the CQA certifying officer and will provide the geosynthetic QA conformance testing required by this CQA Plan, as requested by the CQA monitor and/or CQA certifying officer. The Geosynthetics CQA Laboratory is a third-party, independent testing laboratory that is unaffiliated with the design engineer, materials supplier or manufacturer, or construction

contractor or subcontractors. The Geosynthetics CQA Laboratory will have at least 5 years of experience in testing geosynthetics and other relevant liner system components and will be familiar with American Society for Testing and Materials (ASTM) and other applicable test standards. The Geosynthetics CQA Laboratory will be accredited by the Geosynthetics Accreditation Institute.

4. DEFINITIONS RELATING TO CONSTRUCTION QUALITY ASSURANCE

4.1 Construction Quality Assurance and Construction Quality Control

4.1.1 Construction Quality Assurance

Construction quality assurance is a planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

4.1.2 Construction Quality Control

Construction quality control encompasses those actions that provide a means to measure and control the characteristics of an item or service to meet contractual and regulatory requirements.

4.2 Use of the Terms in This Plan

The definitions used in the context of this CQA Plan are provided below:

- The CQA refers to means and actions employed by the CQA representatives to ensure conformity of liner system preparation, production, and installation with this CQA Plan, the technical specifications, and the construction drawings. The CQA is provided by a party independent from the product manufacturer and construction subcontractor.

- Construction quality control (CQC) refers to those actions taken by manufacturers, suppliers, or construction subcontractors (including their designated representatives) to ensure that the materials and the workmanship meet the requirements of the technical specifications and the construction drawings. In the case of soils, and within this CQA Plan, CQC is typically made a part of the CQA requirements and is provided by the CQA representatives. In the case of geosynthetic and other nonsoil components, CQC is provided by the manufacturers and the construction subcontractor's installers of the various geosynthetics.

5. REFERENCES

5.1 Applicable Organizations

Organizations whose standards are referenced in the CQA Plan are listed below:

- ASTM
- DOE
- Geosynthetic Research Institute
- Occupational Safety and Health Administration
- EPA.

5.2 Applicable Standards

Any reference to standards of any society, institute, association, or governmental agency will pertain to the edition in effect as of the date of this CQA Plan, unless stated otherwise.

Specific test standards for tests cited in the CQA Plan are provided in the technical specifications. These standards may be modified due to technological advances since compilation of the technical specifications. All such modifications are to be approved in accordance with the construction interface document procedures described in Section VIII.

6. CONSTRUCTION ACTIVITIES AND SUBMITTAL REQUIREMENTS

6.1 Construction Activities

This section describes the construction activities and submittal requirements that shall be performed by the construction subcontractor during the ICDF Cell 2 construction. Cell 2 construction will consist of the following activities:

- Remobilizing construction equipment and personnel
- Vendor data submittals
- Installing sediment and erosion control
- Preparing soil bentonite material
- Fine grading of Cell 2 subgrade and construction
- Placing the geosynthetics for the tertiary liner
- Constructing the secondary leak detection recovery system

- Constructing the soil bentonite liner (SBL)
- Placing the geosynthetics for the secondary liner
- Constructing the primary leak detection recovery system
- Placing the geosynthetics for the primary liner
- Constructing the leachate collection recovery system
- Constructing the operations layer
- Site restoration
- Demobilization.

Prior to the start of construction activities, the CQA representatives shall review and become familiar with the RD/CWP, including all construction drawings and technical specifications. The CQA certifying officer also should be familiar with the most recent construction schedule so that adequate resources (i.e., laboratory, field testing equipment, staff, and CQA forms), including contingencies (e.g., backup equipment, alternate laboratory, and alternate CQA staff) for CQA activities, will be commensurate with the anticipated construction productivity and work schedule. All necessary measures should be taken to avoid delaying construction activities and the completion of the ICDF.

SECTION II—SOILS CONSTRUCTION QUALITY ASSURANCE

1. INTRODUCTION

This section addresses the soil components of the liner systems and specifies the soil CQA program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and corrective action requirements.

2. FILL PLACEMENT AND COMPACTION

The technical specifications will be followed for the stockpiling, placement, and compaction of earth fill, structural fill, and base soil. The CQA monitor will monitor the fill placement and compaction to verify and document the following:

- The soil being placed meets the technical specifications' requirements for earth fill, structural fill, or base soil as determined by the test methods and frequencies specified within this CQA Plan
- The placement surface has been prepared as specified in the technical specifications
- The compacted lift thickness is in accordance with the requirements of the technical specifications
- The dry unit weight of the earth fill and structural fill meets specifications as determined by the test methods and frequencies described in Table II-1 for earth fill and Table II-2 for structural fill and base soil
- Material placed in permanent stockpiles meets the appropriate specifications for earth fill or structural fill.

2.1 Construction Quality Assurance Evaluation

The frequency of soil testing for CQA purposes will conform to the minimum frequencies presented in Table II-1 for earth fill and Table II-2 for structural fill and base soils. Material properties shall be determined from samples collected either immediately after placement or from stockpiles.

Nuclear-density-meter test methods will be used for the field testing of the in situ dry unit weight of the in-place, compacted fill. All perforations in the fill will be backfilled and compacted in accordance with the technical specifications.

Standard count calibrations will be conducted to monitor the aging of the nuclear density gauge sources in accordance with ASTM standards. Oven moisture content tests will be conducted and compared to field moisture content results to determine a field correction factor for moisture. Differences within ± 2% are acceptable (no correction is needed). Standard count calibration and in situ moisture content tests shall be performed at the frequencies specified in Tables II-1 and II-2. If an in-place density test result fails to meet specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, a

CQA representative will determine the extent and nature of the defect by observations and/or additional testing as necessary to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the fill, a CQA representative will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA representative deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect are determined and have been remedied by the construction subcontractor, the CQA representative will verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the construction subcontractor in the area of the deficiency. All confirmatory tests, failing tests, and retests shall be recorded in the CQA representative's field book or compaction testing form. The approximate location and elevation of each test shall be recorded based on a predefined grid system or survey.

3. PREPARED SUBGRADE

The CQA representative will verify and document that the prepared subgrade is constructed to the elevations and grades shown in the construction drawings with subgrade meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Upon completion of the excavation of the landfill and evaporation ponds, the CQA monitor will perform the following tasks:

- Inspect the subgrade on the side slopes and base of the landfill or evaporation ponds and note areas of weak or excessively weathered subgrade materials
- Observe the proof rolling of the base of the landfill or evaporation ponds and note areas that exhibit excessive rutting, heaving, or softening
- Observe that the surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice, or frozen material
- Verify that a survey has been conducted to verify that the subgrade grades and elevations conform to the construction drawings
- Verify that the prepared subgrade material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table II-8
- Verify that perforations in the prepared subgrade at testing and sampling locations are plugged or backfilled so that the prepared subgrade meets the technical specifications
- Document the location and volume of the unsuitable material removed from the prepared subgrade and report any nonconformance with the technical specifications in accordance with the nonconformance reporting procedures described in Section VIII.

Unsuitable material found in the prepared subgrade will be removed and replaced in accordance with the technical specifications. A CQA representative will observe any excavation and backfilling operations.

3.1 Layer Completion Certification

The construction subcontractor will be required to notify the CQA representative when an area of prepared subgrade is complete prior to constructing the overlying layer. The CQA certifying engineer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer, certifying that the area is complete prior to placement of subsequent overlying material. The CQA certifying engineer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer after placement of subsequent overlying material only if the construction subcontractor and the ICDF project engineer agree to proceed with the overlying material prior to CQA certification.

4. SOIL BENTONITE LINER AND TEST PADS

The SBL is composed of a preselected base soil and bentonite material admix and is herein referred to as the SBL test pads.

A test pad is not required since the materials, methods, and equipment are the same as that used for Cell 1. However, if a test pad should be required, it shall be constructed by the construction subcontractor in accordance with the specification to determine acceptable placement and compaction methods to produce a low permeable SBL on a horizontal surface.

4.1 Test Pads

4.1.1 Construction Quality Assurance Evaluation

Extensive CQA testing, observation, and data collection are required for the SBL. The CQA testing will be performed during preprocessing and placement of the SBL. The CQA team will conduct the preprocessing and placement tests specified in Table II-4. The maximum allowable percentage of failing tests is specified in Table II-5.

4.1.1.1 Preprocessing. The CQA representative shall monitor and verify that the preprocessing methods are performed in accordance with the SBL described in this CQA Plan and the technical specifications.

4.1.1.2 Placement. During test pad construction, the CQA representative shall continuously observe and document the construction of the test pad and take photographs of its construction.

In order that the test pad shall accurately represent the performance of the full-scale facility, the guidelines below shall be followed:

- Construction of the test pad shall use the same soil material, design specifications, equipment, and procedures as proposed for the full-scale facility
- The test pad length, width, and depth shall be as required by ASTM D6391, “Standard Test Method for Field Measurement of Hydraulic Conductivity Limits of Porous Materials Using Two Stages of Infiltration from a Borehole”
- The number of lifts used to construct the test pad shall be as required by the technical specifications.

The test pad shall be constructed to allow determination of the relationship among density, moisture content, and method of compaction. Field variables can affect this relationship and must be carefully measured and controlled, both in the test pad and during construction of the full-scale liner. At a minimum, the following shall be observed and documented.

- Test pad configuration and dimensions
- Compaction equipment type, configuration, and weight
- Number of passes and speed of the compaction equipment
- Speed of the compaction equipment traveling over the liner

- Uncompacted and compacted lift thickness
- Weather conditions, including ambient temperature, humidity, wind speed and direction, and precipitation.

The CQA representative shall be responsible for all testing, identifying test locations, and documentation necessary to verify that the test pad performs in accordance with the technical specifications and that the methods, equipment, and materials used can achieve the same results or better during full-scale construction.

Testing methods and frequencies shall be as indicated in Table II-3. Additional tests may be conducted at the direction of the CQA certifying officer. All tests shall be conducted in accordance with the methods and procedures specified in Table II-3. The CQA certifying officer shall recommend changes to compaction methods, if necessary, to the ICDF project engineer.

4.2 Soil Bentonite Liner

The CQA team will verify and document that the SBL is placed to the elevations, grades, and thicknesses shown in the construction drawings with bentonite-amended material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

4.2.1 Construction Quality Assurance Evaluation

Extensive CQA testing, observation, and data collection are required for the SBL. The CQA testing will be performed during preprocessing and placement of the SBL. The CQA team will conduct the preprocessing and placement tests specified in Table II-4. The maximum allowable percentage of failing tests is specified in Table II-5.

4.2.1.1 Preprocessing. Prior to amending the base soil with bentonite, a CQA representative will verify and document the following:

- Equipment and methods are the same or equivalent as determined from the test pad studies
- All submittals have been reviewed and approved
- The base soil borrow source area has been approved by the design engineer or ICDF project engineer
- The mixing area is suitable for amending bentonite with base soils
- The base soil does not contain clods with dimensions in excess of those required by the technical specifications
- Lift thickness is less than or equal to the mixing depth of the mixing equipment.

During preprocessing, the CQA representative will verify and document the following:

- The bentonite is in conformance with the technical specifications

- Close observation of the base soil excavation and preprocessing with earthmoving equipment is performed by the field inspector
- The preprocessed SBL material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table II-4
- The moisture content and consistency of base soil allows bentonite to be mixed uniformly
- Bentonite amendments are mixed uniformly with the base soil
- The bentonite is mixed with the base soil during dry weather conditions
- The preprocessed SBL material is stored, protected, and allowed to cure in accordance with the conditions and minimum requirements of the technical specifications
- The bentonite is mixed at the required application rate and thickness established by the specifications as determined by the CQA testing methods and frequency in Table II-4.

The CQA representative will document the properties of the preprocessed soil bentonite material as determined by the test methods and frequency prescribed by this CQA Plan and will report any nonconformance with the technical specifications.

The CQA representative will observe preprocessing activities, including base soil excavation, bentonite blending, and moisture conditioning. Test methods for verifying the bentonite application rate developed during the Cell 1 construction will be used to determine the quantity of bentonite added to the base soils.

The CQA representative will monitor the excavation of base soil from the approved borrow source. Deleterious base soil or base soil not meeting the technical specifications shall be identified and reported to the CQA certifying officer and not allowed in the preprocessing area.

The CQA tests may be performed on the raw bentonite used in the SBL to verify conformance to the technical specifications. When tests are performed, the CQA representative will collect samples of raw bentonite delivered to the site for testing. The CQA laboratory technician will conduct liquid limit, free swell, and grain size tests of the bentonite in accordance with Table II-4. If the test results of a sample fail to meet specifications, a confirmatory test will be performed immediately subsequent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed from the same bentonite load. If the second confirmatory test also meets or exceeds specifications, the bentonite load will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, the load will be rejected and removed from the site.

Test methods for verifying the bentonite application rate developed during the Cell 1 construction will be used to determine the quantity of bentonite added to the base soils. The CQA representative will observe mixing and test the bentonite-amended soil prior to placing it in the ICDF landfill. The CQA tests listed in Table II-4 that do not have acceptance criteria specified in the technical specifications will be performed for information purposes.

4.2.1.2 Placement. Prior to placement of the SBL, the CQA representative will verify and document the following:

- All or an approved portion of the excavation are complete and that a survey has been conducted to verify that the subgrade grades and elevations conform to the construction drawings
- The prepared subgrade meets specifications as determined by the test requirements of this CQA Plan
- The surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice, or frozen material
- If frozen subgrade material is encountered, it is removed and replaced in accordance with the technical specifications
- The SBL material is free of roots, stumps, vegetation, or any other type of deleterious material that could impact the performance of the placed SBL
- The SBL material does not contain stones with dimensions in excess of those required by the technical specifications
- The SBL material meets or exceeds the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table II-4
- The moisture content of the SBL material is uniform.

During placement and compaction of the SBL, the CQA team will verify and document the following:

- Close observation of the placement and compaction of SBL material with earthmoving equipment is performed by the field inspectors.
- The SBL material meets the requirements of the technical specifications as determined by the CQA testing methods and frequency in Table II-4 and maximum allowable failure rates in Table II-5.
- The SBL is placed in accordance with the conditions and minimum requirements of the technical specifications.
- Each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the technical specifications as determined by the CQA testing methods and frequency in Table II-4.
- Shelby tube samples are collected for laboratory permeability testing at the frequency specified in Table II-4.
- Perforations in the SBL at testing and sampling locations are repaired in accordance with the technical specifications.
- The SBL is maintained until it is covered by the geomembrane liner in accordance with the technical specifications.
- In areas of inaccessibility by the Cat 825 compactor, in areas of nonstandard SBL placement, and/or in areas of different compaction methods, more frequent testing shall be performed due to thinner lift thicknesses to achieve equivalent compactive effort. Each lift, no matter how thin, may

be tested for density and moisture in accordance with Table II-4 at the discretion of the CQA representative.

The CQA representative will document the properties of the SBL as determined by the test methods and frequency prescribed by this CQA Plan and will report any nonconformance in accordance with the nonconformance reporting described in Section VIII.

The CQA representatives will collect samples immediately prior to placing a loose lift of SBL materials for property tests prior to compaction. Once compacted, nuclear density meter test methods will be used for testing the in situ compacted dry unit weight and moisture content of the SBL. Standard count calibration and moisture content tests will be used to calibrate the reading of the nuclear density meter and, in cases of uncertainty, with the nuclear density meter readings. Standard count calibration and in situ moisture content tests using the oven dry method shall be performed at the frequencies specified in Table II-4. The results of the oven dry moisture content tests shall be compared with the field moisture content results to determine a field moisture correction factor. The CQA representative shall adjust the field moisture correction factor as test data are collected (i.e., moving average). The CQA representative will collect Shelby tube samples of the SBL for laboratory permeability tests as specified in Table II-4.

If in-place density test results fail to meet specifications, a confirmatory test will be performed immediately adjacent to (within 3 ft of) the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to (within 3 ft of) the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, additional testing will be performed to identify the limits of the area that does not meet project specifications. All confirmatory tests, failing tests, and retests shall be recorded in the CQA representative's field book or compaction testing form. The approximate location and elevation of each test shall be recorded based on a predefined grid system or survey.

Rapid laboratory permeability tests such as the constant volume tests should be used when possible to determine permeability. Once the sample has achieved the specified permeability, the test result will be reported immediately to the CQA certifying engineer. The number of failing tests shall be less than the maximum percentage of failing tests specified in Table II-5. The maximum percentage of failing tests are anticipated to cover mistakes, math errors, or other unknown circumstances that are not discovered until after the layer is covered with the succeeding layer(s).

If a defective area is discovered in the SBL other than a failed in-place density test, the CQA representative will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA representative deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect are determined and have been remedied by the construction subcontractor, the CQA representative will verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the construction subcontractor in the area of the deficiency.

The testing frequency during the SBL construction may be increased or modified at the discretion of the CQA certifying engineer when visual observations of construction performance indicate potential problems or when field experience with the proposed SBL material has been obtained.

During construction, the frequency of testing may be increased by the CQA representative during adverse weather conditions, if equipment breaks down, at the start and finish of grading, if the material fails to meet the requirements of the technical specifications, or the extent of the work area is reduced.

The construction subcontractor will repair all perforations in the SBL resulting from sampling and other CQA activities in accordance with the technical specifications. These perforations shall be identified to the construction subcontractor by the CQA representative. All repairs shall be inspected by the CQA representative.

The construction subcontractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction subcontractor will be required to immediately make all repairs and replacements necessary. The CQA representative will verify and document that all damages are repaired.

The tie-in of the Cell 2 liner to the existing Cell 1 liner is particularly critical. The construction subcontractor will be required to adhere strictly to the drawing requirements. At the discretion of the CQA certifying officer, additional tests may be performed to ensure effective tie-in for liner performance.

4.2.2 Layer Completion Certification

The construction subcontractor will be required to notify the CQA representative when an area of SBL is complete prior to constructing the overlying layer. The CQA certifying engineer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer certifying that the area is complete prior to placement of subsequent overlying material. If the construction subcontractor and the ICDF project engineer agree to proceed with the placement of overlying material prior to CQA certification, the CQA certifying engineer can provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer after placement of subsequent overlying material.

The CQA certifying engineer shall ensure that all CQA tests are complete and that all defective areas have been repaired and retested in accordance with this CQA Plan and the technical specifications. The certificate of layer completion will indicate that the SBL meets the low-permeability requirement based on laboratory tests and the thickness of the SBL meets the minimum requirement specified in the technical specifications.

5. GRAVEL AND SAND

5.1 Conformance Evaluation

The test methods and frequency for CQA conformance testing of the leachate collection recovery system (LCRS), leak detection recovery system (LDRS), and secondary leachate detection recovery system (SLDRS) gravels and sand are specified in Table II-6.

If the material fails to meet the requirements of the technical specifications, the CQA representative will perform sufficient sampling and testing to identify the extent of the nonconforming material. Nonconforming material will be removed from the site.

5.2 Placement and Compaction

The CQA representative will verify and document that the gravel or sand is constructed to the elevations, grades, and thicknesses shown in the construction drawings with material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the gravel or sand, the CQA representative will verify and document that:

- The underlying geosynthetic layers are free of holes, tears, excessive wrinkles, or foreign objects
- All work on underlying layers is complete and accepted by the CQA certifying officer.

During placement and compaction of the gravel or sand, the CQA representative will verify and document the following:

- Gravel or sand material satisfies the requirements of the technical specifications as determined by the testing prescribed within the CQA Plan
- Gravel material is nonangular and free of material that could damage the underlying liner materials
- Gravel material is spread during cooler portions of the day, unless otherwise approved by the CQA certifying officer
- Spreading and hauling equipment and operations are in compliance with material thickness and operation requirements given in the technical specifications
- If excessive wrinkles begin to develop in the underlying geosynthetics during gravel or sand placement or spreading, the wrinkles are worked out prior to continued placement operations
- The gravel or sand is placed in a manner that will not damage underlying geosynthetics, will minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics in accordance with the technical specifications
- Close observation of the placement and compaction of gravel or sand with earth moving equipment is performed.

5.3 Construction Quality Assurance Evaluation

No density tests will be conducted on the gravel or sand. If the CQA representative suspects damage to pipes or underlying geosynthetic, the construction subcontractor will be required to expose the potentially damaged materials and repair any observed damage.

5.4 Layer Completion Certification

The construction subcontractor will be required to notify the CQA representative when an area of the LCRS gravel is complete prior to constructing the overlying layer. The CQA certifying officer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer certifying that the area is complete prior to placement of subsequent overlying material. The CQA certifying engineer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer after placement of subsequent overlying material only if the construction subcontractor and the ICDF project engineer agree to proceed with the overlying material prior to CQA certification.

6. OPERATIONS LAYER

The CQA representative will verify and document that the operations layer is constructed to the elevations, grades, and thicknesses shown in the construction drawings with material meeting the requirements of the technical specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the operations layer, the CQA representative will verify and document the following:

- The underlying geosynthetic layer is free of holes, tears, excessive wrinkles, or foreign objects
- All work on underlying layers is complete and accepted by the CQA certifying officer.

During placement of the operations layer, the CQA representative will verify and document that:

- The soil is suitable and satisfies the requirements of the technical specifications as determined by the test methods and frequencies prescribed in Table II-7
- The operations soil is placed in accordance with the technical specifications and construction drawings
- The lift thicknesses and total thickness of the operations layer agree with the requirements of the construction drawings
- If excessive wrinkles begin to develop in the underlying geosynthetics during material placement or spreading, the wrinkles are worked out prior to continued placement operations
- The operations layer is placed in a manner that will not damage underlying geosynthetics, will minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics in accordance with the technical specifications
- Spreading and hauling equipment and operations are in compliance with material thickness and operation requirements given in the technical specifications
- The operations layer is placed on the side slopes to the limits shown in the construction drawings
- No operations layer material is placed or compacted during periods of unfavorable weather conditions, such as after heavy rains or snow, in accordance with the requirements given in the technical specifications.

6.1 Conformance Evaluation

The test methods and frequencies for CQA conformance testing for the operations layer are specified in Table II-7.

If damage to underlying geosynthetics is suspected, the CQA representative will require that the overlying operations layer material be removed to expose the geosynthetics.

The construction subcontractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction subcontractor will be required to immediately make all repairs and replacements necessary. The CQA representative will verify and document that all damages are repaired.

7. SOIL SURVEYING

A survey shall be performed by or under the direction of a professional land surveyor registered in the State of Idaho. The surveyor shall independently survey the elevations and grades of the soil layers including, but not limited to, those listed below:

Landfill

- Top of prepared subgrade
- Top of SLDRS sand
- Top of LCRS gravel
- Top of SBL
- Top of operations layer.

Surveys will be performed on the base and side slopes of the landfill to confirm that the grades and elevations in the field agree with those shown in the construction drawings and minimum acceptable tolerances required in the technical specifications. The surveys will be performed in accordance with the requirements described in Section VIII. The results of the survey conducted by the surveyor will be compiled in a report signed by the surveyor and the CQA certifying officer.

The surveyor will be required to survey each soil layer of the liner system for the ICDF landfill Cell 2 in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying officer by the surveyor before the placement of the next liner system layer. Verification surveys will be conducted on at least 10% of the 50-ft grid points or break in grade across the entire area of survey. The survey shall include, but not be limited to, the following features of the landfill and evaporation ponds:

- Toe of slope
- Crest of slope
- Grade breaks
- Anchor trench
- SLDRS, LDRS, and LCRS sumps.

Tables II-1 and II-2 show the minimum frequency of testing for the CQA evaluation of earth fill and structural fill and base soil, respectively. Table II-3 shows the test pad testing methods and minimum frequency. Table II-4 shows the minimum frequency of testing for the CQA evaluation of soil bentonite liner. Table II-5 shows the maximum percentage of failed tests for the CQA evaluation of soil bentonite liner. Tables II-6, II-7, and II-8 show the minimum frequency of testing for the CQA evaluation of gravel, the operations layers, and prepared subgrade, respectively.

Table II-1. Minimum frequency of testing for construction quality assurance evaluation of earth fill.

Test	Frequency	Standard Test Method
Material Properties		
Standard proctor for free-draining soil	1 per 20,000 yd^3 (minimum 1 per source or soil type)	ASTM 698
Sieve analysis	1 per 20,000 yd^3 (minimum 1 per source or soil type)	ASTM D422
Atterberg limits	1 per 20,000 yd^3 (minimum 1 per source or soil type)	ASTM D4318
Placement		
In-place wet unit weight	1 per 10,000-yd^2 lift	ASTM D2922
In-place moisture content	1 per 10,000 yd^2	ASTM D3017
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per day of fill placement	ASTM D2216

ASTM = American Society for Testing and Materials

Table II-2. Minimum frequency of testing for construction quality assurance evaluation of structural fill and base soil.

Test	Frequency	Standard Test Method
Material Properties		
Standard proctor	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D698
Sieve analysis	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D422
Atterberg limits	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D4318
Placement		
In situ moisture content	1 per 10,000 ft^2 per lift	ASTM D3017
In situ dry unit weight	1 per 10,000 ft^2 per lift	ASTM D2922
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per day of fill placement	ASTM D2216

ASTM = American Society for Testing and Materials

Table II-3. Test pad testing methods and minimum frequency.

Test	Frequency	Standard Test Method
Material Property		
Modified proctor	4 per each soil type per test pad	ASTM D1557
Atterberg limits	4 per each soil type per test pad	ASTM D4318
Natural moisture content	4 per each soil type per test pad	ASTM D2216
Particle size distribution	4 per each soil type per test pad	ASTM D422
Standard proctor	2 per each soil type per test pad	ASTM D698
In Place		
Bentonite volume measurement	3 per each soil type per test pad	Measure bentonite on tarpaulin or drop cloth at the mixing pad (procedure to be determined in the field).
Maximum clod size	Continuous monitoring	Not applicable
In-place moisture content	4 per lift	ASTM D3017
In-place wet unit weight	4 per lift	ASTM D2922
Shelby tube samples (laboratory permeability)	1 per lift	ASTM D1587/ASTM D5084[a]
Boutwell permeameter test	5 for the horizontal test pad	ASTM D6391, first stage only
Calibration and Check		
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per lift	ASTM D2216
In-place wet unit weight	1 per lift	ASTM D1556, D2167, or D2937

a. The effective confining stress shall be 5 psi.
ASTM = American Society for Testing and Materials

Table II-4. Minimum frequency of testing for construction quality assurance evaluation of soil bentonite liner.

Test	Frequency	Standard Test Method
Bentonite		
Dry fineness	1 per lot	Technical specification[a]
High swelling	1 per lot	Technical specification
Colloid content	1 per lot	Technical specification
Preprocessing		
Base soil excavation	Continuous	Observation
Atterberg limits	1 per working day of hauling base material or per material color/consistency change	ASTM D4318
Bentonite application	Continuous	Observation

Table II-4. (continued).

Test	Frequency	Standard Test Method
Bentonite application rate	Continuous	Field measurement or observation
Clod size	Continuous	Observation
Curing[c]	1 per 12 hours	Observation
Precompaction		
Lift thickness[d]	1 per 2,500 ft^2 per lift	Field measurement
Percent fines	1 per 1,000 yd^3 (minimum of 1 per day of placement)	ASTM D1140
Percent gravel	1 per 1,000 yd^3 with a minimum of 1 per day of placement	ASTM D422
Atterberg limits	1 per 1,000 yd^3 (minimum of 1 per day of placement)	ASTM D4318
Placement	Continuous	Observation
Postcompaction		
Rapid moisture content	5 per acre per lift	ASTM D3017
Rapid dry unit weight	5 per acre per lift	ASTM D2922
Oven moisture content	1 per 10 rapid moisture content	ASTM D2216
Standard count calibration	1 per day of placement	ASTM D2922/ASTM D3017
Shelby tube samples (laboratory permeability)	1 per acre per lift (minimum of 1 per day of placement)	ASTM D1587/ ASTM D5084[e]
Number of passes[f]	Observe 1 per acre per lift	Observation
Construction oversight	Continuous	Observation

a. The test method is described in the technical specification.

b. The test method for determining the application rate of bentonite shall be the site-specific method selected for the test pad construction during Phase 1.

c. Curing is stockpiling the SBL material for 12 hours to allow the bentonite to hydrate.

d. A loose lift thickness is such that the compacted thickness is 6 in. or less.

e. The effective confining stress shall be 5 psi.

f. A single pass is defined as forward and back.

ASTM = American Society for Testing and Materials

Table II-5. Maximum percentage of failed tests for construction quality assurance evaluation of soil bentonite liner.

Test	Maximum percentage
Percent gravel	5% not concentrated in one lift or one area
Clod size	10% not concentrated in one lift or one area
Rapid moisture content	3% not concentrated in one lift or one area, and no water content less than 2% or more than 3% of the specified value
Rapid dry unit weight	3% not concentrated in one lift or one area, and no dry unit weight less than 5 pcf below the specified value
Shelby tube samples (laboratory permeability)	5% not concentrated in one lift or one area

Table II-6. Minimum frequency of testing for construction quality assurance evaluation of gravel.

Test	Frequency	Standard Test Method
Preplacement		
Sieve analysis	1 per 2,500 yd^3	ASTM D422

ASTM = American Society for Testing and Materials

Table II-7. Minimum frequency of testing for construction quality assurance evaluation of operations layer.

Test	Frequency	Standard Test Method
Preplacement		
Sieve analysis	1 per 5,000 yd^3 placed (minimum 1 per source)	ASTM D422

ASTM = American Society for Testing and Materials

Table II-8. Minimum frequency of testing for construction quality assurance evaluation of prepared subgrade.

Test	Frequency	Standard Test Method
Material Properties[a]		
Standard proctor for free-draining soil	1 per 250,000 ft^2 (minimum 1 per source or soil type)	ASTM D698
Sieve analysis	1 per 250,000 ft^2 (minimum 1 per source or soil type)	ASTM D422
Atterberg limits	1 per 250,000 ft^2 (minimum 1 per source or soil type)	ASTM D4318
In Place[b]		
In-place wet unit weight	1 per 10,000 ft^2	ASTM D2922
In-place moisture content	1 per 10,000 ft^2	ASTM D3017
Standard count calibration	1 per day when in-place tests are performed	ASTM D3017/D2922
Over moisture content (in situ moisture content)	1 per day when in place tests are performed	

a. Prior to final grading
b. After final grading
ASTM = American Society for Testing and Materials

SECTION III—GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE

1. GEOSYNTHETIC CLAY LINER MANUFACTURE AND DELIVERY

1.1 Labeling

The CQA representative will verify and document that the geosynthetic clay layer (GCL) manufacturer has labeled each roll of GCL and includes the information required by the technical specifications.

The CQA representative will examine GCL rolls upon delivery, and deviation from the above requirements will be reported to the CQA certifying officer prior to installation of the GCL.

1.2 Transportation and Handling

The CQA representative will observe and document that the type of GCL handling equipment used by the installer minimizes damage to the material.

Upon delivery at the site, the CQA representative conducts a visual inspection of all rolls for defects and for damage. This examination will be conducted without unrolling rolls unless visible defects or damages are found. The CQA representative will indicate to the CQA certifying officer:

- Any rolls that should be unrolled to allow for their inspection
- Any rolls, or portions thereof, that should be rejected and removed from the site because they have severe flaws
- Any rolls that include minor repairable flaws.

1.3 Storage

The CQA representative will verify and document that storage of the GCL is in accordance with the technical specifications.

1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried. The inventory shall include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data have been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

A CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing should be set aside for sampling as soon as possible.

The CQA representative shall record the information listed below, at a minimum, for each roll.

- **Manufacturer—**Indicate the manufacturer of the material that is being inventoried, which may not be the same as the installer.
- **Date of Inventory—**Date that the material was inventoried.
- **Date of Delivery—**Enter date when the truck arrived onsite, if known.
- **Truck Type—**Indicate type of truck used for shipping geosynthetics (flatbed [covered or uncovered], box trailer, etc.).
- **Bill-of-Lading No.—**If the bill-of-lading is available, indicate number and date (also attach copy to inventory form).
- **CQA Representative—**Indicate name of CQA representative performing inventory.
- **Unloading Equipment—**Indicate the type and model number of the equipment unloading the geosynthetic material. Also note any special attachments that are used to unload the material (stinger, straps, forks, etc.).
- **Weather Conditions—**Describe the weather conditions (including temperature, wind, cloud cover, and precipitation) during unloading and conformance sampling operation.
- **Material Type—**Indicate type of geosynthetic material.
- **Roll Number—**Indicate each roll number that is indicated on the roll. The roll numbers contain a variety of information regarding the material and the manufacturing process.
- **Lot Number—**Lot number.
- **Roll (L × W)—**Indicate the roll width as indicated on the roll label. If two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials.
- **Area (ft^2)—**Indicate the total square footage of the roll.
- **Damage Remarks—**Document any visible damage to the roll. If possible, indicate if damage was present prior to unloading or if it occurred during unloading.

The subcontractor's representative will be responsible for processing the material in accordance with PRD-5008, "Control of Purchased Items."

1.5 Quality Assurance Conformance Testing

Either at the manufacturers' plant or upon delivery of the rolls of GCL, the CQA representative will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 ft along the length of the roll. Unless otherwise specified, samples will be 1.5 ft (minimum) long by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 100,000 ft^2, whichever is greater. These samples will be tested for the following:

- Bentonite moisture content, ASTM D4643
- GCL permeability, ASTM D5084
- Bentonite mass per unit area, ASTM D5993
- Swell index test, ASTM D5890
- Grab peel strength, ASTM D4632.

Test shall be conducted in accordance with the test procedure presented in the technical specifications.

The CQA representative will examine all results from laboratory conformance testing and will compare the results to the specifications presented in the technical specifications. In addition, the CQA representative will report any nonconformance to the CQA certifying officer as soon as practical after the test results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction subcontractor will be required to replace the roll (or rolls) of GCL not in conformance with the specifications with a roll that meets the requirements of the technical specifications.
- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fail to meet the requirements, samples will be collected from the five numerically closest untested rolls on both sides of the failed samples and tested by the Geosynthetics Laboratory. These 10 samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of GCL onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory.
- The CQA representative will document actions taken in conjunction with conformance test failures and report all actions to the certifying officer.

2. GEOSYNTHETIC CLAY LINER INSTALLATION

2.1 Earthwork

2.1.1 Surface Preparation

For fill surfaces that will underlay a GCL layer, prior to placement of GCL, the CQA representative will verify and document the following:

- The surface of the fill does not contain holes, ruts, protrusions, or other surface irregularities in excess of those dimensions specified by the technical specifications
- The surface of the fill has been compacted to form a firm, stable base
- The surface of the fill is free of any type of deleterious material that may cause damage to the GCL, including debris, organic material, frozen soil, ice, and rocks
- The surface of the fill is free of standing water or excessive moisture
- The construction subcontractor has certified in writing that the surface on which the GCL will be installed is acceptable.

The subgrade surface will be inspected immediately prior to commencement of GCL installation. If any change in the surface requires repair work, in accordance with the technical specifications, the construction subcontractor will be responsible for repairing the fill surface.

A certificate of subgrade surface acceptance will be required from the construction subcontractor. The CQA representative shall verify that the subgrade is accepted by the GCL installer immediately prior to commencement of GCL installation.

After the surface on which the GCL is to be installed has been accepted by the construction subcontractor, it will be the CQA representative's responsibility to indicate to the CQA certifying officer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying officer requires repair work, it will be the responsibility of the construction subcontractor to repair the underlying layer.

2.1.2 Anchor Trenches and Sumps

Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify and document the following:

- The sumps and anchor trenches are excavated to the grades and dimensions shown in the construction drawings. Any anomalies in the soil encountered during excavation will be brought to the attention of the ICDF project engineer and removed as directed.
- The anchor trench excavation surface is prepared for installation of geosynthetics, with rounded corners, and free of loose soil or deleterious material.

After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify and document that the backfill for the geosynthetic anchor trenches is placed and compacted in accordance with the technical specifications.

2.2 Geosynthetic Clay Liner Deployment

2.2.1 Field Panel Identification

A field panel is the unit area of GCL that is to be placed in the field (i.e., a field panel is a roll or a portion of roll cut in the field).

The CQA representative shall track the placement location of each GCL panel by assigning an identification code (number or letter-number) or by an equivalent tracking method. The identification method shall be agreed upon by the CQA certifying officer and the construction subcontractor. This field panel identification scheme should be as simple and logical as possible. (Note: Manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the construction subcontractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA representative will establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all CQA records.

2.2.2 Field Panel Placement

2.2.2.1 Installation Schedule. The CQA representative will evaluate significant changes in the schedule proposed by the construction subcontractor and advise the CQA certifying officer on the acceptability of that change. The CQA representative will verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the construction subcontractor in accordance with the technical specifications.

2.2.2.2 Weather Conditions. The CQA representative will verify and document that GCL is not placed during inclement weather conditions, as specified within the technical specifications. Additionally, the CQA monitor will verify and document that the existing underlying layer has not been damaged by weather conditions.

2.2.2.3 Damage. The CQA representative will visually observe each panel, after placement, for damage. The CQA representative will inform the construction subcontractor which panels (or portions of panels) should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by the CQA representative will be marked, and their removal from the work area will be documented by the CQA representative.

2.2.2.4 Seam Overlap and Bentonite Seal. The construction subcontractor will observe and document that the seam overlaps and bentonite material placed between panels, if required, along the seams meet specification guidelines. The CQA representative will verify overlap width and will observe bentonite seal placement.

2.2.3 Field Panel Protection

The CQA representative will observe and document that the GCL is completely covered with geomembrane at the end of each workday and protected from damage and hydration due to weather. The CQA representative will verify and document that equipment does not operate directly on the GCL and that a smooth rub sheet is used to maneuver textured geomembrane over the GCL to prevent damage to the GCL.

2.3 Defects and Repairs

2.3.1 Identification

All seams and nonseam areas of the GCL will be inspected by the CQA representative for evidence of defects, holes, contamination of geotextiles, displaced panels, premature hydration, and any sign of contamination by foreign matter. The CQA representative will observe and document repair procedures described below.

2.3.2 Repair Procedures

Prior to cover material placement, damage to the GCL shall be identified and repaired by the installer.

2.3.2.1 Rip and Tear Repair (Flat Surfaces). Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place) with a minimum overlap of 12 in. on all edges.

Accessory bentonite should be placed between the patch edges and the repaired material at a rate of 0.25 lb per lineal ft of edge spread in a continuous 6-in. fillet.

2.3.2.2 Rip and Tear Repair (Slopes). Damaged GCL material on slopes shall be repaired by the same procedures above; however, the overlapped edges of the patch should be wide enough to ensure that the patch will keep its position during backfill or cover operations.

2.3.2.3 Displaced Panels. Displaced panels shall be adjusted to the correct position and orientation. The adjusted panel shall then be inspected for any geotextile damage or bentonite loss. Damage shall be repaired by the above procedure.

2.3.2.4 Premature Hydration. If the GCL is subjected to premature hydration, the construction subcontractor shall notify the CQA certifying officer for a site-specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design dependent upon the degree of damage. If hydration exceeds 100%, the material is deemed unacceptable.

SECTION IV—GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

1. GEOMEMBRANE MATERIAL

1.1 Labeling

The CQA representative will verify and document that the geomembrane manufacturer has labeled each roll of geomembrane and includes the information required by the technical specifications.

The CQA representative will examine geomembrane rolls upon delivery and deviation from the above requirements will be reported to the CQA certifying officer prior to installation of the geomembrane.

1.2 Transportation and Handling

Upon delivery at the site, the CQA representative will conduct a visual inspection of all rolls for defects and for damage. This examination will be conducted without unrolling rolls unless visible defects or damages are found. The CQA representative will indicate the following to the CQA certifying officer:

- Any rolls that should be unrolled to allow for their inspection
- Any rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws
- Any rolls that include minor repairable flaws.

1.3 Storage

The CQA representative will verify and document that storage of the geomembrane is in accordance with the technical specifications.

1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried. The inventory shall include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data have been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

A CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing should be set aside for sampling as soon as possible.

The CQA representative shall record the information listed below, at a minimum, for each roll.

- **Manufacturer—**Indicate the manufacturer of the material that is being inventoried, which may not be the same as the installer.

- **Date of Inventory—**Date that the material was inventoried.
- **Date of Delivery—**Enter date when the truck arrived onsite, if known.
- **Truck Type—**Indicate type of truck used for shipping geosynthetics (flatbed [covered or uncovered], box trailer, etc.).
- **Bill-of-Lading No.—**If the bill-of-lading is available, indicate number and date (also attach copy to inventory form).
- **CQA Representative—**Indicate name of CQA representative performing inventory.
- **Unloading Equipment—**Indicate the type and model number of the equipment unloading the geosynthetic material. Also note any special attachments that are used to unload the material (stinger, straps, forks, etc.).
- **Weather Conditions—**Describe the weather conditions (including temperature, wind, cloud cover, and precipitation) during unloading and conformance sampling operation.
- **Material Type—**Indicate type of geosynthetic material (high-density polyethylene, geotextile, or geonet).
- **Roll Number—**Indicate each roll number that is indicated on the roll.
- **Lot Number—**Lot number as indicated (2456 in example shown above).
- **Roll (L × W)—**Indicate the roll width as indicated on the roll label. If two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials.
- **Area (ft^2)—**Indicate the total square footage of the roll.
- **Damage Remarks—**Document any visible damage to the roll. If possible, indicate if damage was present prior to unloading or if it occurred during unloading.

The subcontractor's representative will be responsible for processing the material in accordance with PRD-5008, "Control of Purchased Items."

1.5 Quality Assurance Conformance Testing

Either at the manufacturers' plant or upon delivery of the rolls of geomembrane, the CQA representative will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the technical specifications.

Conformance samples will be taken by the CQA representative across the entire width of the roll and will not include the first 3 ft. Unless otherwise specified, samples will be 1.5 ft (minimum) long by the roll width. The CQA representative will mark the direction of the machine used to cut the samples with an arrow.

Unless otherwise specified, samples will be taken at a rate of one per lot or one per 100,000 ft^2, whichever is greater. These samples will be tested for:

- Specific gravity, ASTM D1505
- Thickness, ASTM D5994
- Yield strength and yield elongation, ASTM D638
- Carbon black content, ASTM D1603
- Carbon black dispersion, ASTM D5996
- Puncture resistance, ASTM D4833-e1.

Test shall be conducted in accordance with the test procedure presented in the technical specifications.

The CQA representative will examine all results from laboratory conformance testing and will report any nonconformance after the test results become available.

Whenever a sample fails a conformance test that is conducted by the CQA representative, the procedure specified in ASTM D 4759, "Standard Practice for Determining the Specification Conformance of Geosynthetics," shall be followed.

The construction subcontractor will be required to replace the roll (or rolls) of geomembrane in nonconformance with the technical specifications with a roll that meets the technical specifications.

2. GEOMEMBRANE INSTALLATION

2.1 Earthwork

2.1.1 Surface Preparation

For SBL surfaces that will underlay a geomembrane layer, prior to placement of geomembrane, the CQA representative will verify and document the following:

- The surface of the subgrade or SBL does not contain holes, depressions, or protrusions in excess of those dimensions specified by the technical specifications
- The surface of the subgrade or SBL has been rolled with a smooth drum roller to form a firm, stable base without ridges, wheel ruts, and surface irregularities
- The surface of the subgrade or SBL is free of any type of deleterious material that could cause damage to the geomembrane
- The construction subcontractor has certified in writing that the surface on which the geomembrane will be installed is acceptable.

The subgrade and SBL surface will be inspected immediately prior to commencement of geomembrane installation. If any change in the surface requires repair work, in accordance with the technical specifications, the construction subcontractor will be responsible for repairing the surface.

A certificate of subgrade surface acceptance will be required from the construction subcontractor. The CQA representative shall verify that the subgrade is accepted by the geomembrane installer immediately prior to commencement of geomembrane installation.

After the surface on which the geomembrane is to be installed has been accepted by the construction subcontractor, it will be the CQA representative's responsibility to indicate to the CQA certifying officer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying officer requires repair work to be done, it will be the responsibility of the construction subcontractor to repair the underlying layer.

2.1.2 Anchor Trenches and Sumps

Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify and document the following:

- The excavation of the sumps and anchor trenches is performed in accordance with the technical specifications. Any anomalies in the soil encountered during excavation will be brought to the attention of the ICDF project engineer and removed as directed.
- The anchor trench excavation surface is prepared for installation of geosynthetics with rounded corners and is free of loose soil or deleterious material.

After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify and document that the backfill for the geosynthetic anchor trenches is placed and compacted in accordance with the technical specifications and construction drawings.

2.2 Geomembrane Deployment

2.2.1 Layout Drawing

The construction subcontractor will be required to produce layout drawings that show the geomembrane panel configuration, dimensions, details, seam locations, etc. The layout drawings must be approved by the CQA certifying officer prior to the installation of the geomembrane.

2.2.2 Field Panel Identification

A field panel is the unit area of geomembrane that is to be seamed in the field (i.e., a field panel is a roll or a portion of roll cut in the field).

The CQA representative will verify that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code will be agreed upon by the CQA representative and the construction subcontractor. This field panel identification code should be as simple and logical as possible. (Note: Manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the construction subcontractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA representative will establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all CQA records.

2.2.3 Field Panel Placement

2.2.3.1 Location. The CQA representative will verify and document that field panels are installed at the locations and positions indicated in the construction subcontractor's layout plan, as approved or modified by the CQA certifying officer.

2.2.3.2 Installation Schedule. The CQA representative will evaluate significant changes in the schedule proposed by the construction subcontractor and advise the CQA certifying officer on the acceptability of that change. The CQA representative will verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the construction subcontractor in accordance with the technical specifications.

The CQA representative will record the identification code, location, and date of installation of each field panel.

2.2.3.3 Weather Conditions. The CQA representative will verify and document that the geomembrane is not placed during inclement weather conditions as specified within the technical specifications.

Additionally, the CQA representative will verify and document that the underlying layer has not been damaged by weather conditions.

2.2.3.4 Damage. The CQA representatives will visually observe each panel, after placement and prior to seaming, for damage (e.g., holes, blisters, and creases). The CQA representative will inform the construction subcontractor which panels (or portions of panels) should be rejected, repaired, or accepted.

Damaged panels or portions of damaged panels that have been rejected by the CQA certifying officer will be marked, and their removal from the work area will be documented by the CQA representative.

2.3 Field Seaming

2.3.1 Seam Layout

The CQA certifying officer will verify and document that the seam layout shown in the panel layout drawing (Part 2.2.1) is consistent with the technical specifications. A seam numbering system compatible with the panel numbering system will be agreed upon by the construction subcontractor and CQA certifying officer.

2.3.2 Seaming Equipment and Products

Processes approved by the technical specifications for field seaming are (1) extrusion seaming and (2) fusion seaming. Proposed alternate processes will be required to be documented and submitted to the CQA certifying officer for approval. The construction subcontractor will be required to use a pyrometer to ensure that accurate temperatures of the extrudate and seamer nozzle are being achieved.

The extrusion seaming apparatus will be equipped with gauges indicating the temperatures of the extrudate and nozzle. The construction subcontractor will be required to provide to the CQA certifying officer the manufacturers' certification that the extrudate is compatible with the geomembrane material and is comprised of the same resin as the geomembrane.

The CQA representative will log ambient temperatures, seaming apparatus temperatures, and extrudate temperatures or fusion seaming apparatus speeds. Ambient temperatures will be measured to verify compliance with the technical specifications.

2.3.3 Seam Preparation

The CQA certifying officer will verify and document the following:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material
- Preparation of seams is in accordance with the technical specifications.

2.3.4 Weather Conditions for Seaming

The CQA representative will verify and document that weather conditions for seaming are within the limits specified in the technical specifications.

2.3.5 Trial Seams

The construction subcontractor will be required to make trial seams on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. The construction subcontractor will be required to make and test trial seams at the frequency and in accordance with the methods specified in the technical specifications.

The CQA representative will observe all trial seam procedures. The trial seam samples will be assigned a number and marked accordingly by the CQA representative, along with the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. A sample of the trial

seam will be retained by the CQA team until construction of the liner is complete and the liner has been accepted by the CQA certifying officer.

2.3.6 Nondestructive Seam Continuity Testing

2.3.6.1 Introduction. Except as otherwise noted in the technical specifications, the construction subcontractor will nondestructively test all field seams over their full length in accordance with the technical specifications. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing will be carried out as the seaming work progresses, not at the completion of all field seaming. Nondestructive testing will not be permitted before sunrise or after sunset unless the construction subcontractor demonstrates to the CQA certifying officer that the construction subcontractor has the capabilities to perform continuity testing under reduced light conditions.

The CQA representative will perform the following tasks:

- Observe the continuity testing
- Record location, date, test unit number, name of tester, and outcome of all testing
- Document and inform the construction subcontractor of any required repairs.

The construction subcontractor will be required to complete any required repairs in accordance with the technical specifications.

The CQA representative will perform the following tasks:

- Observe the repair and re-testing of the repair
- Mark on the geomembrane that the repair has been made
- Document the results.

The CQA representative will verify and document the procedures specified in the technical specifications where seams cannot be nondestructively tested.

The location, date of visual observation, name of tester, and outcome of the test or observation will be recorded by the CQA representative and reported to the CQA certifying officer.

2.3.7 Destructive Seam Testing

2.3.7.1 Concept. Destructive seam tests will be performed at selected locations. The purpose of these tests is to evaluate seam strength and integrity. Seam strength testing will be done as the seaming work progresses, not at the completion of all field seaming.

2.3.7.1.1 Location and Frequency—The CQA representative will select locations where seam samples will be cut out for laboratory testing. In general, destructive tests shall be located in noncritical areas, such as seam run-out areas or near three-panel intersections or other areas that would require a patch anyway. In addition, because extrusion welding may be limited on a daily basis, extrusion destructive samples may be welded after a passing trial seam on scrap material not used for construction. However, when significant lengths (greater than 100 ft) of seams or caps are extrusion welded, a destructive test of the weld will be taken. An initial testing frequency of 1 per 500 ft of fusion seaming

and 1 destructive test per day taken from nonproduction areas for extrusion welding will be met for each combination of welding machine and technician. (This minimum frequency is to be determined as an average taken throughout the entire Cell 2.) Control charts will be used to track the performance of each welding machine and technician to allow for biased sampling according to performance. An upper control limit (UCL) will be established to statistically identify the sources of test failures. Machines and technicians whose failure rates exceed the UCL will then be identified and destructively tested at twice the original frequency (1 per 250 ft for fusion and 2 per day for extrusion) to better monitor their performance. Once the failure rate drops back into compliance with the UCL, the original testing frequency will be reinstated. Machines and technicians whose failure notes are below the UCL will be identified to decrease the original frequency as approved by the CQA certifying officer.

The UCL is established based on the failure rate for all destructive tests plus three standard deviations with a ceiling of 3.5%. The ceiling is the maximum failure rate determined to be acceptable as agreed upon jointly by the construction subcontractor and CQA certifying officer. The initial UCL will be calculated once a single machine or technician fails two destructive tests and will be typically updated daily with the most recent destructive testing results. Destructive tests tracking a failed destructive will not be included in the calculation of the failure rates.

Additional destructive test locations may be required during seaming operations. The necessity for such additional sampling and testing will be determined by CQA representatives and will be implemented when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other reason to suspect potentially defective seams. The location selection of the additional testing will be based on the CQA representative's judgment and observation of a suspected problem.

The construction subcontractor will not be informed in advance of the locations where the seam samples will be taken.

2.3.7.2 Sampling Procedure. The construction subcontractor will be required to cut samples as directed by the CQA representative as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The CQA representative will perform the following tasks:

- Observe sample cutting
- Assign a number to each sample and mark it accordingly
- Record the sample number and location on the panel layout drawing
- Record the reason for taking the sample at this location (routine testing, suspicious feature of the geomembrane, etc.).

All holes in the geomembrane resulting from destructive seam sampling will be covered by the construction subcontractor immediately after sampling and repaired in accordance with the repair procedures described in the technical specifications. The continuity of the new seams in the repaired area will be nondestructively tested according to the technical specifications.

2.3.7.3 Size of Samples. At a given sampling location, two types of samples will be required to be taken by the construction subcontractor.

First, two specimens for field testing will be taken. Each of these specimens will be 1 in. wide by 6 to 12 in. long with the seam centered parallel to the width. The distance between these two specimens

will be approximately 42 in. If both specimens pass the field test described in the technical specifications, a sample for laboratory testing will be taken.

The sample for laboratory testing will be required to be taken between the two specimens for field testing. The destructive sample will be 12 in. wide by 42 in. long with the seam centered lengthwise. The sample will be cut into three parts and distributed as follows:

- One portion to the construction subcontractor, 12 in. long
- One portion to the CQA certifying officer for archive storage, 12 in. long
- One portion to the CQA certifying officer for CQA Laboratory testing, 18 in. long.

Final determination of the sample sizes will be made at the preconstruction meeting.

2.3.7.4 Field Testing. The two 1-in.-wide specimens specified above will be required to be tested in the field, by the CQA representative or the installer, by tensiometer for peel and should not fail in the seam. If any field test sample fails to pass, the procedures outlined in the technical specifications will be required to be followed. The CQA representative will mark all samples and portions with their number, date, and time.

2.3.7.5 Geosynthetic Construction Quality Assurance Laboratory Testing. Laboratory destructive test samples will be packaged and shipped to the INEEL Materials Testing Laboratory located at the Central Facilities Area Building 602 by the CQA representative in a manner that will not damage the test sample. The CQA representative will store the archive samples until the completion of the project. Laboratory destructive test samples will be tested by the INEEL Laboratory.

Testing will include "shear strength" and "peel strength" (ASTM D6392) with 1-in.-wide strip, tested at 2 in. per minute. The minimum acceptable values to be obtained in these tests are those indicated in the technical specifications. At least five specimens will be tested for each test method. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear). At least four out of five of the specimens for each test must pass.

The Laboratory will provide test results verbally to the CQA certifying officer in a timely manner after they receive and test the samples. The CQA certifying officer will review laboratory test results as soon as they become available and will inform the CQA certifying officer of the test results.

2.3.7.6 Procedures for Destructive Test Failure. The procedures specified within the technical specifications will be required whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory or by field tensiometer. The CQA certifying officer will verify and document that one of the options specified within the technical specifications is followed. The CQA representative will document all actions taken in conjunction with destructive test failures.

2.4 Defects and Repairs

2.4.1 Identification

All seams and nonseam areas of the geomembrane will be inspected by the CQA representative for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be required to be clean at the time of examination. The geomembrane surface will be

required to be swept or washed by the construction subcontractor if the amount of dust or mud inhibits examination.

2.4.2 Evaluation

Each suspect location both in seam and nonseam areas will be required to be either nondestructively tested using the methods described in the technical specifications or repaired (as appropriate) as determined by the CQA certifying officer. Each location that fails the nondestructive testing will be marked by the CQA representative and will be required to be repaired by the construction subcontractor. Materials should not be placed over geomembrane locations that have been repaired until the CQA representative has approved the repair.

2.4.3 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA representative will visually inspect the geomembrane for wrinkles. Based on the requirements of the technical specifications, the CQA representative will indicate to the construction subcontractor which wrinkle (if any) should be cut, overlapped, and seamed to remove the wrinkle. The seam thus produced will be tested like any other seam.

2.4.4 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, will be repaired by the construction subcontractor in accordance with the applicable method specified within the technical specifications. Each repair will be located and logged by the CQA representative.

2.4.5 Testing of Repairs

Each repair will be nondestructively tested using the methods described in the technical specifications, as appropriate. Repairs that pass the nondestructive test will be considered as an adequate repair. Large caps may be of sufficient extent to require destructive testing, at the discretion of the CQA certifying officer. Failed tests will require the repair to be redone and retested until passing test results are obtained. The CQA representative will observe the nondestructive testing of repairs and will document the date of the repair and test outcome.

2.5 Appurtenances

The CQA representative will verify and document the following:

- Installation of the geomembrane around, and connection of geomembrane to, appurtenances have been made according to the technical specifications or manufacturers' recommendations
- Extreme care is taken while seaming around appurtenances since neither nondestructive nor destructive testing may be feasible in these areas
- The geomembrane has not been visibly damaged while being connected to appurtenances.

The CQA representative will inform the CQA certifying officer if the above conditions are not fulfilled.

3. GEOMEMBRANE PANEL LAYOUT SURVEY

A survey shall be performed by or under the direction of a professional land surveyor registered in the State of Idaho. The surveyor will independently survey the elevations and location of each panel intersection and destructive sample. The surveys will be performed in accordance with the requirements described in Section VIII. The results of the survey conducted by the surveyor will be compiled in a report signed by the surveyor and the CQA certifying officer.

The surveyor will be required to survey each geomembrane panel intersection and destructive sample location for the ICDF landfill and evaporation ponds in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying officer by the surveyor. The survey will include enough information to confirm that the geomembrane layout is in accordance with the panel layout and will include, but not be limited to, the information listed below:

- Geomembrane panel intersections
- Destructive sample location and identification
- Edge of geomembrane liner
- Panel identification numbers.

Each geomembrane layer shall be surveyed including, but not be limited to, the following:

- Tentiary geomembrane
- Secondary geomembrane
- Primary geomembrane.

4. LAYER COMPLETION CERTIFICATION

The construction subcontractor will be required to notify the CQA representative when an area of geomembrane is complete prior to constructing the overlying layer. The CQA certifying officer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer certifying that all CQA tests are complete and all defects have been repaired and tested prior to placement of subsequent overlying material. The CQA certifying engineer shall provide a certificate of layer completion to the construction subcontractor and the ICDF project engineer after placement of subsequent overlying material only if the construction subcontractor and the ICDF project engineer agree to proceed with the overlying material prior to CQA certification.

SECTION V—GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE

1. GEOTEXTILE MATERIAL AND INSTALLATION

1.1 Labeling

The CQA representative will verify and document that the geotextile manufacturer has labeled all rolls of geotextile with the information specified in the technical specifications.

The CQA representative will examine rolls upon delivery and any deviation from the above requirements will be reported to the CQA certifying officer. Geotextile rolls that are not labeled or that have illegible labels will be removed and disposed of by the construction subcontractor.

1.2 Transportation and Handling

The CQA representative will observe rolls of geotextile upon delivery at the site and any deviation from the transportation and handling requirements specified within the technical specifications will be reported to the CQA certifying officer. Any damaged rolls will be rejected by the CQA certifying officer and required to be repaired or replaced by the construction subcontractor.

1.3 Storage

The CQA representative will verify and document that storage of the geotextile is in accordance with the technical specifications.

1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried. The inventory shall include the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data have been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

A CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing should be set aside for sampling as soon as possible.

The CQA representative shall record the information listed below, at a minimum, for each roll.

- **Manufacturer—**Indicate the manufacturer of the material that is being inventoried, which may not be the same as the installer.
- **Date of Inventory—**Date that the material was inventoried.
- **Date of Delivery—**Enter date when the truck arrived onsite, if known.
- **Truck Type—**Indicate type of truck used for shipping geosynthetics (flatbed [covered or uncovered], box trailer, etc.).

- **Bill-of-Lading No.—**If the bill-of-lading is available, indicate number and date (also attach copy to inventory form).

- **CQA Representative—**Indicate name of CQA representative performing inventory.

- **Unloading Equipment—**Indicate the type and model number of the equipment unloading the geosynthetic material. Also note any special attachments that are used to unload the material (stinger, straps, forks, etc.).

- **Weather Conditions—**Describe the weather conditions (including temperature, wind, cloud cover, and precipitation) during unloading and conformance sampling operation.

- **Material Type—**Indicate type of geosynthetic material.

- **Roll Number—**Indicate each roll number that is indicated on the roll.

- **Lot Number—**Lot number.

- **Roll (L × W)—**Indicate the roll width as indicated on the roll label. If two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials.

- **Area (ft^2)—**Indicate the total square footage of the roll.

- **Damage Remarks—**Document any visible damage to the roll. If possible, indicate if damage was present prior to unloading or if it occurred during unloading.

The subcontractor's representative will be responsible for processing the material in accordance with PRD-5008, "Control of Purchased Items."

1.5 Conformance Testing

Either at the manufacturers' factory or upon delivery of the geotextile rolls, the CQA representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the requirements of the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 ft along the edge of the roll. Unless otherwise specified, samples will be 1.5 ft (minimum) long by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Samples will be taken at a rate of one per material lot or one per 100,000 ft^2, whichever is greater. These samples will be tested for the following:

- Mass per unit area

- Grab strength

- Tear strength

- Puncture strength.

(Note: All tests should be conducted in accordance with the test methods listed in the technical specifications.)

If the geotextile is being used as a filter or separator, the samples also will be tested for apparent opening size.

The CQA representative will examine all results of laboratory conformance testing and report any nonconformance to the CQA certifying officer as soon as results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction subcontractor will be required to replace the roll (or rolls) of geotextile not in conformance with the specifications with a roll that meets the requirements of the technical specifications.

- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fail to meet the requirements, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These 10 samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geotextile onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory. The cost of all such tests are to be borne by the construction subcontractor.

The CQA representative will document actions taken in conjunction with conformance test failures and report all actions taken to the CQA certifying officer.

1.6 Deployment

The construction subcontractor will be required to handle all geotextile in such a manner as to ensure that the geotextile is not damaged in any way.

It shall be the CQA representative's responsibility to indicate to the CQA certifying officer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying officer requires repair work, it will be the responsibility of the construction subcontractor to repair the underlying layer.

The CQA representative will verify and document compliance with the following:

- Just prior to geotextile placement, the layer that underlies the geotextile—if it is a geosynthetic—is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the liner system.

- In the presence of excessive wind, the geotextile is weighted with sandbags (or equivalent weight approved by the CQA representative).

- Minimize the presence of wrinkles in the geotextile. If necessary, the geotextile is positioned by hand after being unrolled to minimize wrinkles.

- Geotextile is cut using a geotextile cutter approved by the geotextile manufacturer and the CQA representative. If in place, special care is taken to protect other materials (such as underlying geosynthetics) from damage that could be caused by the cutting of the geotextiles.

- The construction subcontractor takes any necessary precautions to prevent damage to the underlying layers during placement of the geotextile.

- During placement of geotextiles, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying layers, generate clogging of drains or filters, or hamper subsequent seaming.

- Geotextile is not left exposed for an excess of 8 weeks after placement to prevent damage from exposure to ultraviolet radiation (sunlight).

The CQA representative will document any noncompliance with the above requirements and report them to the CQA certifying officer.

1.7 Seams and Overlaps

The CQA representative will verify and document that all geotextile seams are oriented and overlapped in accordance with the technical specifications.

The construction subcontractor will be required to pay close attention at seams to ensure that no protective soil layer material could be inadvertently placed beneath the geotextile.

1.8 Repair

The CQA representative will verify and document that any holes or tears in the geotextile are repaired in accordance with the requirements of the technical specifications.

The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying officer.

SECTION VI—GEOCOMPOSITE CONSTRUCTION QUALITY ASSURANCE

1. GEOCOMPOSITE MATERIAL AND INSTALLATION

1.1 Labeling

The CQA representative will verify and document that the geocomposite manufacturer has labeled all rolls of geocomposite as specified within the technical specifications.

The CQA representative will examine rolls upon delivery and any deviation from the above requirements will be reported to the CQA certifying officer prior to installation of the geocomposite.

1.2 Transportation and Handling

The CQA representative will observe rolls of geocomposite upon delivery at the site and any deviation from the requirements of the technical specifications will be reported to the CQA certifying officer. Any damaged rolls will be rejected by the CQA representative and will be required to be repaired or replaced by the construction subcontractor.

1.3 Storage

The CQA representative will verify and document that the storage of the geocomposite is in accordance with the technical specifications.

1.4 Inventory

All geosynthetic materials that arrive onsite will be inventoried. The inventory will record the specific roll numbers delivered with each shipment. The inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the material tested is the same material that was delivered to the site. Material for which QC testing data have been supplied will be sampled for conformance testing. Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA representative.

A CQA representative will monitor the unloading operations and will inventory the material. Rolls selected for conformance testing should be set aside for sampling as soon as possible.

The CQA representative shall record the information listed below, at a minimum, for each roll.

- **Manufacturer—**Indicate the manufacturer of the material that is being inventoried, which may not be the same as the installer.
- **Date of Inventory—**Date that the material was inventoried.
- **Date of Delivery—**Enter date when the truck arrived onsite, if known.
- **Truck Type—**Indicate type of truck used for shipping geosynthetics (flatbed [covered or uncovered], box trailer, etc.).

- **Bill-of-Lading No.—**If the bill-of-lading is available, indicate number and date (also attach copy to inventory form).

- **CQA Representative—**Indicate name of CQA representative performing inventory.

- **Unloading Equipment—**Indicate the type and model number of the equipment unloading the geosynthetic material. Also note any special attachments that are used to unload the material (stinger, straps, forks, etc.).

- **Weather Conditions—**Describe the weather conditions (including temperature, wind, cloud cover, and precipitation) during unloading and conformance sampling operation.

- **Material Type—**Indicate type of geosynthetic material (high-density polyethylene, geotextile, or geonet).

- **Roll Number—**Indicate each roll number that is indicated on the roll.

- **Lot Number—**Lot number as indicated (2456 in example shown above).

- **Roll (L × W)—**Indicate the roll width as indicated on the roll label. If two materials are bonded together (i.e., geonet/geotextile), obtain measurements for both materials.

- **Area (ft^2)—**Indicate the total square footage of the roll.

- **Damage Remarks—**Document any visible damage to the roll. If possible, indicate if damage was present prior to unloading or if it occurred during unloading.

The subcontractor's representative will be responsible for processing the material in accordance with PRD-5008, "Control of Purchased Items."

1.5 Conformance Testing

Either at the manufacturers' plant or upon delivery of the geocomposite rolls, the CQA representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the requirements of the technical specifications.

Conformance samples will be taken across the entire width of the roll and will not include the first 3 ft. Unless otherwise specified, samples will be 1.5 ft long (minimum) by the roll width. The CQA representative will mark the machine direction on the samples with an arrow.

Samples will be taken at a rate of one per lot or one per 100,000 ft^2, whichever is greater. These samples will be tested for peel strength and hydraulic transmissivity in accordance with the test methods presented in the specification.

The CQA representative will examine all results from laboratory conformance testing and will report any nonconformance to the CQA certifying officer as soon as the results become available.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics CQA Laboratory:

- The construction subcontractor will be required to replace the roll (or rolls) of geocomposite not in conformance with the specifications with a roll that meets the requirements of the technical specifications.

- The CQA representative will ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fail, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These 10 samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geocomposite onsite and a sample from every roll that is subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory. The cost of such tests is to be borne by the construction subcontractor.

The CQA representative will document actions taken in conjunction with conformance test failures and report all actions to the CQA certifying officer.

1.6 Deployment

The construction subcontractor will be required to handle all geocomposite in such a manner as to ensure that it is not damaged.

The construction subcontractor responsible for geocomposite installation will be required to certify in writing that the surface on which the geocomposite will be installed is complete and acceptable. The certificate of partial completion will be required to be given by the construction subcontractor to the CQA representative, who will then verify to the CQA certifying officer that the deployment surface is complete prior to commencement of geocomposite installation in the area under consideration.

After the surface on which the geocomposite is to be installed has been accepted by the construction subcontractor, it will be the CQA representative's responsibility to indicate to the CQA certifying officer any change in the underlying layer that may, in accordance with the technical specifications, require repair work. If the CQA certifying officer requires repair work, it will be the responsibility of the construction subcontractor to repair the underlying layer.

The CQA representative will verify and document compliance with the following:

- Just prior to geocomposite placement, the layer that will underlie the geocomposite is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the underlying layers or clog the drainage system.

- In the presence of excessive wind, the geocomposite is weighted with sandbags (or equivalent weight approved by the CQA certifying officer).

- Minimize the presence of wrinkles in the geocomposite. If necessary, the geocomposite is positioned by hand after being unrolled to minimize wrinkles.

- Geocomposites are cut using a geocomposite cutter approved by the geocomposite manufacturer and the CQA representative. If in place, special care is taken to protect other materials from damage that could be caused by the cutting of the geocomposites.

- The geosynthetics construction subcontractor takes all necessary precautions to prevent damage to the underlying layers during placement of the geocomposite.

- Geocomposite is not welded to geomembranes.

- During placement of clean geocomposite, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.

- A visual examination of the geocomposite is carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects (such as needles) are present.

- Geocomposite is not left exposed for an excess of 8 weeks after placement to prevent damage from exposure to ultraviolet radiation (sunlight).

The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying officer.

1.7 Seams and Overlaps

The components of the geocomposite (e.g., geotextile-geonet-geotextile) are not bonded together at the ends and edges of the rolls. The CQA representative will document that the geocomposite is overlapped and secured in accordance with the technical specifications.

1.8 Repair

The CQA representative will verify that any holes or tears in the geocomposite are repaired in accordance with the technical specifications.

The CQA representative will observe any repair, document any noncompliance with the above requirements, and report the noncompliance to the CQA certifying officer.

SECTION VII—POLYETHYLENE PIPE AND FITTINGS

1. PIPE AND FITTINGS

The CQA representative shall monitor the placement of the SLDRS and LCRS pipe located on the ICDF landfill floor and riser pipes located on the landfill slopes.

1.1 Labeling

The CQA representative will verify that the pipe is labeled with the information specified in the technical specifications. Any deviations from the labeling requirements will be reported to the CQA certifying officer prior to pipe installation.

1.2 Transportation and Handling

The CQA representative will verify and document that the pipe and fittings are handled in accordance with the technical specifications.

The CQA representative will visually inspect the pipe upon delivery at the site and any deviations from the requirements of the technical specifications will be reported to the CQA certifying officer.

1.3 Storage

The CQA representative will verify and document that storage of the pipe and fittings is in accordance with the technical specifications.

1.4 Inventory

The CQA representative shall inventory the polyethylene piping and fitting delivered to the site that will be installed at the bottom and on the slopes of the landfill and evaporation pond. The CQA representative shall perform the following tasks:

- Verify the material for conformance with the specifications and drawings
- Check the material for damage, mishandling, and adverse exposure.

The subcontractor's representative will be responsible for processing the material in accordance with PRD-5008, "Control of Purchased Items."

1.5 Conformance Testing

No conformance testing will be conducted on the materials delivered to the site.

1.6 Handling and Laying

The CQA representative will verify and document that the pipe is installed at the specified locations and grades and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the technical specifications and in a manner intended to prevent damage to the pipe.

The pipe and fittings will be carefully examined before installation by the CQA representative. The CQA representative will verify and document that cracks, damage, or defects are not present in the pipe and fittings in excess of that allowed by the technical specifications.

The CQA representative also will note the condition of the interior of pipes and fittings. Foreign material shall be removed from the pipe interior before it is moved into final position. No pipe will be permitted to be placed until the CQA representative has observed the condition of the pipe. The CQA representative will document any deviation from the above requirements and report it to the CQA certifying officer.

1.7 Joints and Connections

Lengths of pipe will be required to be assembled into suitable installation lengths by the butt-fusion process. Butt-fusion refers to the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure.

The CQA representative will spot-monitor the butt-fusion welding operations to ensure that the construction subcontractor follows the technical specifications.

The CQA representative will document any noncompliance with the above requirements and report it to the CQA certifying officer. Additional inspections will be performed by others to verify compliance with technical specifications.

1.8 Surveying

A survey shall be performed by or under the direction of a professional land surveyor registered in the State of Idaho. The surveyor will independently survey the final elevation and alignment of the top of the pipe and fittings. Surveys will be performed on all pipe locations within the footprint of the landfill to confirm that the alignment and elevations in the field agree with those shown in the construction drawings. The surveys will be performed in accordance with the requirements described in Section VIII. The results of the survey conducted by the surveyor will be compiled in a report signed by the surveyor and the CQA certifying officer.

The surveyor will be required to survey at least 10% of the pipe locations within the ICDF landfill in accordance with the requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying officer by the surveyor before the placement of the next liner system layer. The surveys will be conducted every 50 ft along the pipe alignment and appurtenances. The survey will include enough information to confirm that the following features of the landfill and evaporation pond piping are constructed in accordance with the construction drawings:

- Beginning and end top of pipe elevations
- Connection location
- Grade breaks
- Riser pipes
- Sump extensions.

The piping that shall be surveyed will include, but not be limited to, the following:

- SLDRS piping
- LCRS piping.

The CQA certifying officer will approve the survey results for each layer before the subsequent component of the lining system is constructed.

SECTION VIII—CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

1. DOCUMENTATION

A major function of CQA is to properly and adequately document the work. This section describes the minimum required documentation. The CQA certifying officer may recommend to the STR/construction coordinator additional documentation for performing CQA tasks that are for certification. In addition, the CQA certifying officer shall prepare forms, field data sheets, sample labeling schemes, and chain-of-custody procedures.

1.1 Daily Reports

Daily reports shall be completed by the CQA representatives when they are onsite. All CQA personnel shall be assigned field books by the CQA certifying officer, which shall be labeled with a unique number. The CQA certifying officer shall coordinate with the quality engineer to ensure that the field book numbering complies with the BBWI requirements. The CQA representatives, including the CQA certifying officer, shall record all field observations and the results of field tests either in their assigned field book or on BBWI-approved field data sheets. When not in use, all field books will be left in the field records file. After each book is filled (or at the end of the project), the field book shall be returned to the CQA certifying officer and routed to the project files.

Each page of the field book shall be numbered, dated, and initialed by CQA personnel. At the start of a new work shift, CQA personnel shall list the following information at the top of the page:

- Job name
- Job number
- Date
- Name
- Weather conditions
- Page number (if pages are not prenumbered).

The remaining individual entries shall be prefaced by an indication of the time at which they occurred. If the results of test data are being recorded on separate sheets, it shall be noted in the field book. Entries in the field book shall include, but not be limited to, the following information:

- Reports on any meetings held and their results
- Equipment and personnel being used in each location, including construction subcontractors
- Descriptions of areas being observed and documented
- Descriptions of materials delivered to the site, including any quality verification (vendor certification) documentation

- Descriptions of materials incorporated into construction
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration
- Decisions made regarding use of material and/or corrective actions to be taken in instances of substandard quality
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item.

At the end of each day, the field CQA monitor shall summarize the day's activities on a daily field monitoring report form. The field report shall include a brief summary of the day's activities and highlight any unresolved issues that must be addressed by the CQA certifying officer or by CQA representatives the following day.

The daily field monitoring report shall be filled out in triplicate. The CQA monitor shall attach three copies of the field book notes for that day. The three copies shall be distributed as follows:

- Original shall be filed in field office
- One copy shall be transmitted to the CQA certifying officer
- One copy shall be transmitted to the STR/construction coordinator.

The CQA certifying officer shall review and initial each summary field report before distributing it to the project quality records and the STR/construction coordinator.

1.2 Inspection Data Sheets

All observed field and laboratory test data shall be recorded on an inspection data sheet. At a minimum, each inspection data sheet shall include the following information:

- Unique identifying sheet number for cross-referencing and document control
- Description of the inspection activity
- If appropriate, location of the inspection activity or location from which the sample was obtained
- Type of inspection activity and/or procedure used (reference to standard method when appropriate)
- Any recorded observation or test data with all necessary calculations
- Results of the inspection activity and comparison with specification requirements
- Identification of any personnel involved in the inspection activity
- Signature of the individual(s) performing the CQA representative activity and concurrence by the CQA certifying officer.

Forms used for the data sheets shall be prepared and submitted to the STR/construction coordinator and ICDF project manager in accordance with this section. The data sheets shall include, but are not limited to, the forms listed below:

- Sample log
- Compaction test result log
- Soil test result summary form
- Equipment calibration log.

1.3 Record Drawing Maintenance

The construction subcontractor will maintain a complete set of construction drawings labeled "red-line" as-built drawings. At the completion of the project, the as-built drawings will be produced in electronic format and submitted to the CQA certifying officer. The CQA certifying officer will review the completed set of as-built drawings and certify the drawing set as the record drawings for the ICDF.

1.4 Nonconformance Reporting

A nonconformance is considered to be a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. If a deficiency cannot be repaired or replaced to the satisfaction of the CQA certifying officer within the guidelines established by this CQA Plan, then such a deficiency shall be considered a nonconformance and shall be documented on a nonconformance report (NCR) form in accordance with INEEL's Management Control Procedure (MCP) –538, "Control of Nonconforming Items." The nonconformance shall be referred to the STR/construction coordinator for initiation of corrective action processes. All NCR situations shall be brought to the attention of the CQA certifying officer for concurrence prior to initiating the NCR. Upon issuance of the nonconformance report, the CQA certifying officer shall notify the ICDF project engineer and ICDF construction subcontractor and quality engineer that the report has been issued.

A deficiency that is discovered during the work that has a process already established to correct the deficiency (i.e., failed compaction test or failed geomembrane destructive test) shall be tracked by the CQA representative until it is corrected. A nonconformance report is not required in these cases. All other issues shall be addressed in accordance with MCP-538, as described above.

1.5 Construction Change Process

Construction changes shall be processed in accordance with the implementation subcontractor's contract and quality assurance manual. The change process covered by PRD-5002, "Design Change Control," will be implemented to control changes to the contract documents.

1.6 Progress Reports

The CQA certifying officer shall prepare a summary progress report each week or at time intervals established at the preconstruction meeting. At a minimum, this report shall include the following information:

- A unique identifying sheet number for cross-referencing and document control

- The date, project name, location, and other information
- A summary of work activities accomplished during the progress reporting period
- Identification of areas or items inspected and/or tested during the reporting period that are addressed by the report
- A summary of the quality characteristics being evaluated with appropriate cross-references to specifications and/or drawings
- References to the specifications or drawings defining the acceptance criteria for each inspected characteristic
- A summary of inspection and test results, failures, and retests
- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period
- A summary of other problem resolutions and dispositions
- The signature of the CQA certifying officer.

The progress report shall be submitted to the ICDF project manager no more than 2 days after the last reporting day in the progress report. Copies also shall be submitted to the ICDF project manager, quality engineer, and STR/construction subcontractor.

1.7 Final Documentation

All daily inspection summary reports, inspection sheets, problem identification and corrective measures reports, acceptance reports, construction changes, NCRs, photographic records, progress reports, drawings, drawing revisions, and other pertinent documentation shall be retained as permanent project quality records. At the completion of the project, a final CQA report that incorporates all such information, along with as-built drawings, shall be prepared by the CQA certifying officer and submitted to the ICDF project manager. A final CQA report shall be completed at the end of the Cell 2 construction that will include and certify Cell 2 construction.

The CQA certifying officer shall coordinate the completion of the as-built record drawings, which shall be generated by a land surveyor licensed in the State of Idaho, as described in Section 4.2.3. The as-built records shall include scale drawings depicting depths, plan dimensions, elevations, fill thicknesses, and geosynthetic panel layouts. The report shall include documentation of each construction component monitored by CQA personnel and shall be signed, stamped, and certified by the CQA certifying officer.

1.8 Storage of Records

During the construction of the ICDF, the CQA certifying officer shall be responsible for all CQA documents. This includes the CQA certifying officer's copy of the design criteria, plans, procedures, and specifications; the CQA Plan; and the originals of all the data sheets and reports. The field records shall be kept in locked storage cabinets with access control. The storage cabinets are to be located within a building equipped with fire protection sprinkler system and communication system that provides Fire

Department response. At the completion of the project, all completed documents shall be transferred to BBWI. The BBWI shall then route these documents to the project's central file location in accordance with Plan (PLN) -1178, "Records Management Plan for Construction Projects."

1.9 Storage of Archive Construction Material Samples

The CQA monitor shall be responsible for storing construction material samples collected during the duration of the project.

The CQA monitor shall coordinate with BBWI on which samples shall be archived at the completion of the project. All samples shall be kept in small containers (e.g., 5-gal plastic buckets). Each container shall be labeled with the information listed below:

- Project name
- Date
- Sample ID
- Material type
- Point of contact.

All samples shall be stored neatly in a cool, dry location as approved by the CQA certifying engineer. The CQA certifying engineer shall coordinate with BBWI to determine which sample will be archived at the project completion.

SECTION IX—REFERENCES

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